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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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VOLUME 26 NUMBER 23 / DECEMBER 8, 1988

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) 3167

02 AERODYNAMICS 3171

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY 3174

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 3175

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 3176

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION 3178

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER 3179

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL 3180

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) 3180

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

12 ASTRONAUTICS (GENERAL) N.A.

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS N.A.

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 3182

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES 3183

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION 3183

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING 3183

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 3183

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION N.A.

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 3186

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) 3187

24 COMPOSITE MATERIALS 3188

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 3190

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 3193

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 3195

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 3199

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 3200

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

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Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 3201

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 3201

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 3206

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 3209

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 3215

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 3218

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 3221

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 3223

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 3224

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) **N.A.**

43 EARTH RESOURCES AND REMOTE SENSING **3227**

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **3228**

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **3230**

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **3231**

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **3234**

Includes weather forecasting and modification.

48 OCEANOGRAPHY **3237**

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) **3237**

52 AEROSPACE MEDICINE **3238**

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **3240**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **3241**

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY **N.A.**

Includes exobiology; planetary biology; and extraterrestrial life.

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59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) **N.A.**

60 COMPUTER OPERATIONS AND HARDWARE **3244**

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE **3245**

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS **3264**

Includes computer networks and special application computer systems.

63 CYBERNETICS **3265**

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS **3269**

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY **3273**

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS **3275**

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS **3276**

Includes topology and number theory.

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Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) **3277**

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 3278
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 3280
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 3281
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 3282
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 3283
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 3286
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 3294
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 3296
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 3296
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS 3297
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY N.A.
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 3298
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY N.A.
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 3298
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 3300
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 3308
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 3309
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

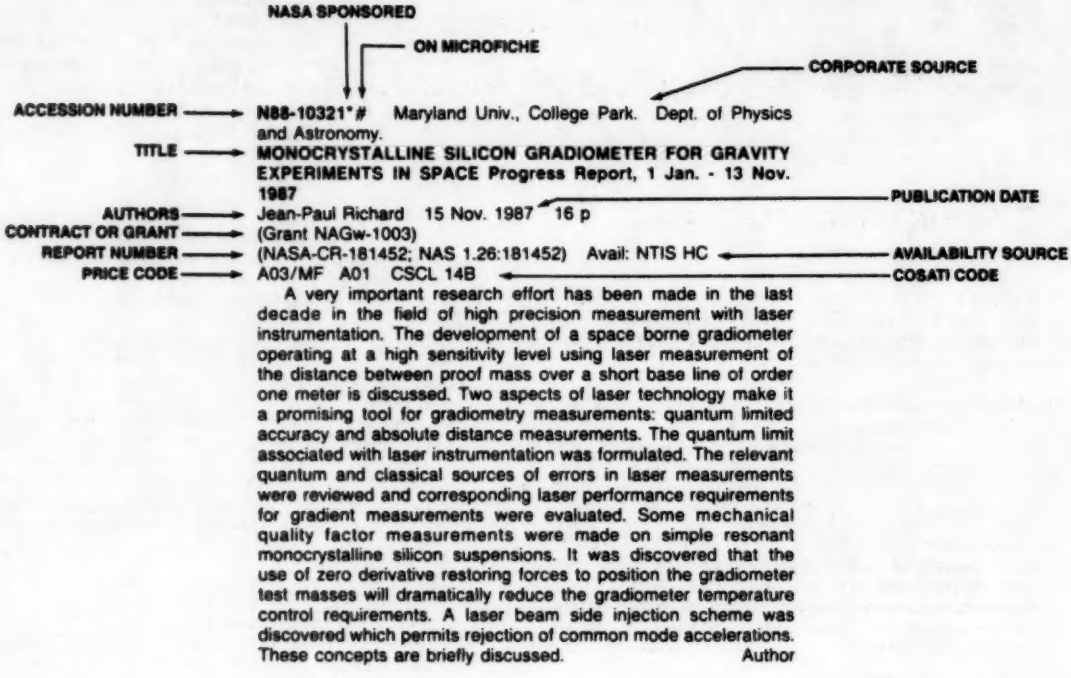
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 3309

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-51
CORPORATE SOURCE INDEX I-59
CONTRACT NUMBER INDEX I-71
REPORT/ACCESSION NUMBER INDEX I-73

TYPICAL CITATION AND ABSTRACT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N88-10321*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
TITLE
MONOCRYSTALLINE SILICON GRADIOMETER FOR GRAVITY EXPERIMENTS IN SPACE Progress Report, 1 Jan. - 13 Nov. 1987
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COSATI CODE
A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 23 / DECEMBER 8, 1988

Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N88-28857# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
BOUNDARY LAYER SIMULATION AND CONTROL IN WIND TUNNELS
Apr. 1988 462 p
(AGARD-AR-224; ISBN-92-835-0457-7) Copyright Avail: NTIS HC A20/MF A01

The results of a study performed by AGARD Working Group 09 on boundary layer simulation in wind tunnels are presented with emphasis on the transonic speed regime. This report is intended to display the current state-of-the-art in boundary layer simulation where Reynolds number is or cannot be simulated and give attention to wind tunnel effects as well as to document the physical aspects of boundary layer simulation and the research needed. Finally, a simulation methodology is proposed which can serve wind tunnel user and operator as an ordered thinking process for the design of wind tunnel tests where viscous effects are important. For individual titles, see N88-28858 through N88-28877.

N88-28858# Potter (J. Leith), Nashville, Tenn.
MISSILES, FUSELAGE AND SIMILAR BODIES **c09**
J. Leith Potter *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 5-20 (For primary document see N88-28857 23-01)
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A review of current practices for coping with the simulation deficiency when tests of elongated bodies are conducted at Reynolds numbers appreciably lower than full-scale values is presented. High subsonic, transonic, and low-supersonic ranges of Mach number are covered; hypersonic conditions are excluded although much of the discussion is also relevant to high Mach number flows. Because the flows considered may or may not have supersonic regions and shock waves, it is important to remain alert to the differences that shock-boundary layer interaction may impose upon any conclusions that are based upon shock-free flows. Drag and side force variations generated by changes in Reynolds number receive the principal attention. The working premise is that the higher Reynolds number simulation goal implies also that a turbulent boundary layer is desired and that it has to be established by artificial means. Author

N88-28859*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HIGH-ASPECT-RATIO WINGS **c09**
John B. Peterson, Jr. *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 21-29 (For primary document see N88-28857 23-01)
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High-aspect-ratio aircraft include most transport aircraft such as commercial and military transports, business aircraft, and cargo aircraft. Generally, these types of aircraft are designed to cruise over a narrow range of lift coefficients and Mach numbers in the performance of their mission. Emphasis is therefore placed on the cruise performance of transport aircraft and every effort is made to obtain accurate wind-tunnel data to use as a basis for prediction of full-scale cruise performance. However, off-cruise performance is also important and methods were developed for extrapolating wind-tunnel data on buffet and flutter at transonic speed. Transport-type aircraft were tested extensively in various wind tunnels around the world and many different test techniques were developed to simulate higher Reynolds numbers. Methods developed for one tunnel may not be applicable to another tunnel because of differences in size, Reynolds number capability, running time, and test objectives. Many of the methods of boundary-layer control developed in two-dimensional airfoil testing can be applied in tests of transport configurations, but sometimes the three-dimensional flow fields that develop on tranpsort aircraft can make application of the two-dimensional methods difficult or impossible. The discussion is intended to be a representative, but not exhaustive, survey of the various methods of high Reynolds number simulation in the testing of high-aspect-ratio aircraft.
Author

N88-28860# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Civil Transport Aircraft Div.
DELTA WING CONFIGURATIONS **c02**
J. Szodruch *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 30-49 (For primary document see N88-28857 23-01)
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The flow field over a slender delta wing at angle of attack immersed in a supersonic stream can be divided into two characteristic regions. The windward or pressure side faces the oncoming flow and is strongly influenced by the bow shock wave; the leeward or suction side is dominated by the effects of inviscid/viscous interaction. It is mainly the leeward flow which is then affected by Reynolds number changes and especially these effects are discussed in more detail. In the past, for subsonic, transonic, and supersonic free stream Mach numbers the essential issue of design with slender wings, where vortices occur over the wing at virtually every flight condition, is to fix the location of the separation lines so that the vehicle is always controllable. This is why Reynolds number effects in these flow regimes were considered of secondary importance. On the other hand at hypersonic speeds the influence of Reynolds number on peak heating as well as on the development and size of characteristic patterns in the flow field are more important. Here hypersonic viscous interaction is dominating, especially near the wing apex, and the vortices induce high rates of heat transfer along the attachment line. The discussion is confined to free stream Mach numbers from high subsonic to supersonic. With respect to Reynolds number effects it is of major importance to define the different types of vortical flow in that velocity range and to consider the influence of wing geometry. Author

N88-28861# British Aerospace Public Ltd. Co., Weybridge (England). Aircraft Group.
COMPLEX CONFIGURATIONS **c09**
A. G. T. Cross *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 50-67 (For primary document see N88-28857 23-01)
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The practice of simulating high flight Reynolds number behavior in a low Reynolds number facility is well known. However the problems now encountered at transonic speeds are considerable

and vary for different model designs such that it is difficult to predict with real confidence the actual flight conditions. In two dimensions these scale effects become more apparent as the degree of supercritical flow is increased and in particular with rearward movement of shocks. In three dimensions the problems are more severe particularly when wing sweep is high due to vortex and turbulent attachment line flows, both of which are Reynolds number dependent and when complex configurations are considered the potential for scale sensitive effects is considerable owing to the many regions where flow separation can occur. The designer will often seek to avoid scale sensitive flow separations in model tests and this amounts to designing for low Reynolds number with a reduction in the potential gains to be had for design for full scale. By furthering the understanding of scale effects more realiable use can be made of Reynolds number simulation techniques, so enabling design for conditions closer to full scale with significant gains in flight performance. The current practice with regard to high Reynolds number simulation in transonic wind tunnels for industrial standards of testing relating to complex aircraft configurations is reviewed. Author

N88-28862# National Aerospace Lab., Amsterdam (Netherlands).
REYNOLDS NUMBER EFFECTS AND THE WIND TUNNEL ENVIRONMENT **c09**

A. Elsenaar *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 68-79 Previously announced as N87-18546 (For primary document see N88-28857 23-01)
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Pseudo Reynolds number effects on wind tunnel test results are discussed. It is shown that many phenomena can be avoided or reduced. However, the natural transition position appears to be critically dependent on a large number of variables: pressure distribution, tunnel noise and turbulence, temperature nonequilibrium, surface roughness, and Reynolds number. For that reason differences in transition location between wind tunnel and flight are likely to occur for other reasons than Reynolds number differences. It remains good practice to either artificially fix the boundary layer or to measure the transition location. ESA

N88-28863# Naples Univ. (Italy). Experimental Gasdynamics
TECHNIQUES FOR BOUNDARY LAYER TRIPPING AND CONTROL **c09**

G. P. Russo *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 80-90 (For primary document see N88-28857 23-01)
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The most used techniques in industrial practice to provoke transition at the desired location on the model rely on narrow strips of sparsely distributed ballotini or carborundum grains. Carborundum is preferred for its sharp irregular shape giving rise to a superior effectiveness in tripping; ballotini are preferred for their closer dimensional control. A new technique trying to combine these two desirable features was proposed which make use of coronets produced with a sewing machine on thin metal strips. Another recently proposed technique makes use of transfer characters (Letraset) build up in layers of the desired thickness. Methods based on the increase of the turbulence level of the stream ahead of the model are to be considered not sufficiently reliable. The two most used techniques to detect transition on 3-D models are both based on surface visualization: the first one makes use of sublimating substances, acenaphtene in high subsonic and transonic tests; the second one makes use of fluorescent oil + ultra-violet light. An alternative technique, promising for its reversibility, is the visualization of temperature distribution on the surface with an infra-red camera (thermography) or with a temperature-sensitive paint. For 2-D or axially-symmetrical models more conventional techniques can be used as measurements of velocity profiles with pitot tubes, boundary layer thickness with optical methods, turbulence levels with hot-wire or Laser-Doppler anemometers. Author

N88-28864# Aircraft Research Association Ltd., Bedford (England).
EXPERIMENTAL TOOLS: THE TUNNEL AND THE MODEL **c09**

A. B. Haines and A. Elsenaar *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 111-114 (For primary document see N88-28857 23-01)
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The aim of the report is to draw attention to experimental factors that can have a significant impact on the details of the methodology to adopt for a particular test program in a particular tunnel. First and foremost, the methodology and in particular, the choice of approach to the in-depth study of the viscous effects is likely to depend on the test Reynolds number and on whether it is possible to vary the Reynolds number by changing the tunnel stagnation pressure (or temperature). If the tests are being made in a variable density tunnel, Reynolds-number sweeps will tend to be the preferred option; if the tests are being made in an atmospheric tunnel, manipulation of the boundary layer to produce a closer representation of the full-scale boundary behavior will be the only possible approach unless one is prepared to test more than one model to a different scale. Whenever possible, both approaches should be practised but nevertheless, the type of tunnel will dictate the preference. Reynolds number, is however, not the only significant parameter. The stream turbulence and noise level are also important. The required standards of tunnel flow quality and data accuracy were set out in the report of an earlier sub-committee of the AGARD Fluid Dynamics Panel. For convenience, however, the main issues that can affect the success of applying either approach to the study of the viscous effects are summarized. Author

N88-28865# National Research Council of Canada, Ottawa (Ontario).
COMPUTATIONAL TOOLS FOR SIMULATION METHODOLOGIES **c09**

Y. Y. Chan *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 115-131 (For primary document see N88-28857 23-01)
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In the brief review of the computational capabilities for viscous flows, it was shown that the methods of solution of the governing equations were well developed. Turbulence modeling is adequate for simple flows, though further verification and developments are still needed for complex flows. Interactions of viscous and inviscid flows, which are basic characteristics of transonic flows are propertly formulated and analyzed. Attached flows can be predicted accurately for a wide range of Reynolds numbers. Flows with moderate separations near the leading or trailing edges and the shock wave-boundary layer interactions can be treated by the interactive methods. Methods for two-dimensional flows are better developed while three-dimensional and unsteady flow methods are showing rapid progress. In general, computations can be applied to simple configurations or components of a complex configuration. The interaction of computational simulations with wind tunnel test programs has effectively augmented the capabilities of these tests. The information provided by computations is now essential for design and checking of the test and for interpretation and extrapolation of the results. Due to strict requirement of accuracy in aerodynamic tests, applications of computation are limited, at present, to stimulation of attached flows. For complex flow simulations, especially with flow separation, further development is needed in better understanding the physical nature of the flow and its modeling. Author

N88-28866# National Aerospace Lab., Amsterdam (Netherlands).
EMPIRICAL TOOLS FOR SIMULATION METHODOLOGIES **c09**

A. Elsenaar and A. B. Haines (Aircraft Research Association Ltd., Bedford, England) *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 132-138 (For primary

document see N88-28857 23-01)
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For the application of a simulation/extrapolation methodology a detailed understanding of the relevant viscous effects is essential. The most sophisticated computational methods today cannot describe all aspects of the flow development. This is particularly true for details of the flow development that involve boundary layer transition and/or separation. For that reason an attempt is made to describe the empirical tools that can be used to supplement the theoretical calculations or the experimental information. The principle of the method is briefly indicated. Also, in many cases, alternative relations can and will be used depending on existing practice and experience of a particular design team. Where possible, in addition to a simple method a more sophisticated method was specified. In some cases the more sophisticated method is almost identical to a complete numerical simulation. In that respect the present set of empirical tools is open-ended. On the one hand, new experimental information will become available in the future to refine or extend the empirical tools as used at present. On the other hand, the ever increasing sophistication in flow modeling through computational methods will eventually supercede most empiricism. Author

N88-28867# Aircraft Research Association Ltd., Bedford (England).
TRANSPORT-TYPE CONFIGURATIONS **c05**
A. B. Haines and A. Elsenaar (National Aerospace Lab., Amsterdam, Netherlands) *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 139-163 (For primary document see N88-28857 23-01)
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Various reasons can be advanced for treating transports as a separate, distinct class of aircraft for the purpose of defining a detailed viscous simulation methodology. The detailed methodology as described was based on past experience and an appreciation of how the advances in computational fluid dynamics can be exploited to place the methodology on a more scientific basis. It is recommended that, to gain experience, the proposed methodology should be applied for a significant period in parallel with whatever is the established practice. Any large differences in the extrapolated results should be assessed to find whether the reasons justify departure from existing practice: in other words, the methodology that was set forth should be better, being on a sound scientific basis, but it will still have to prove itself in the future. Author

N88-28868# Aircraft Research Association Ltd., Bedford (England).
COMBAT AIRCRAFT **c05**
A. B. Haines *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 164-190 (For primary document see N88-28857 23-01)
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Devising a viscous simulation methodology for model tests of a combat aircraft design is more difficult than for a subsonic transport. The geometry is more complicated and hence, more difficult to model for a computational fluid dynamics (CFD) calculation; the flow patterns are more complex and can contain various interacting features; there is more interest in the development of the flow beyond the buffet-onset boundary; the ability to manipulate the boundary layer in the model tests is more limited. The emphasis in the methodology rests on the in-depth study of the flow patterns and, in particular, the identification of the scale-sensitive viscous effects in the flow patterns over the model under test. The description of these flow patterns and of how, in principle, to construct a methodology to meet the various possible situations, is based on past experience and on an awareness of the advances in CFD methods. Author

N88-28869# Potter (J. Leith), Nashville, Tenn.
MISSILES, FUSELAGES AND SIMILAR BODIES **c02**
J. Leith Potter *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 191-208 (For primary document see N88-28857 23-01)
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The flows about elongated bodies are discussed in the context of simulation and scaling. With that as a point of departure, the present discussion is confined to the practice of tripping laminar boundary layers at locations on models selected with the goals of simulating higher Reynolds numbers. Possible flow phenomena and the effects of Reynolds numbers are reviewed. It is suggested that many of the strategies developed mainly in testing airfoils and wing models may also be appropriate when missile and fuselage shapes are involved. B.G.

N88-28870# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
INTRODUCTION AND CRITICAL FLOW PHENOMENA **c02**
E. Stanewsky *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 211-216 (For primary document see N88-28857 23-01)
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The present scope of work can be expressed as follows: review the physics associated with the simulation of high Reynolds number flow and, in particular, determine viscous and outer inviscid flow parameters that dominate viscous/inviscid interaction crucial to the simulation process; define needed research to improve the understanding of the flow physics associated with boundary layer simulation, including research needed to identify and account for wind tunnel environmental effects on the boundary layer simulation; and define experiments and/or computational fluid dynamics (CFD) exercises needed to establish the sensitivity of relevant flow phenomena or flow developments to viscous effects. Author

N88-28871# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
BOUNDARY LAYER DEVELOPMENT AND TRANSITION **c02**
Roger Michel *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 217-249 (For primary document see N88-28857 23-01)
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The principal critical flow phenomena were defined as being very sensitive to modifications of the properties of the incoming boundary layer. The problem is schematized by considering the transonic flow around some profile; the two main critical flow phenomena are the shock-boundary layer interaction region and the downstream separation and trailing-edge flow region. The properties of the boundary layer are analyzed through the three classical aspects of a laminar boundary layer, boundary layer transition and, at last, a turbulent boundary layer. The essential aspects of the phenomena and weighted factors are examined as well as opportunities which exist in order to predict the initial characteristics of the boundary as regards to the critical phenomena. Author

N88-28872# British Aerospace Public Ltd. Co., Weybridge (England). Military Aircraft Div.
DEVELOPMENT AND ANALYSIS OF TURBULENT NON-EQUILIBRIUM BOUNDARY LAYERS **c34**
A. G. T. Cross *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 250-270 (For primary document see N88-28857 23-01)
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The simulation of flow phenomena involving a boundary layer was already identified as potentially very sensitive to the upstream state of the incoming layer. The state of the layer in the sense of being laminar, transitional, or turbulent is of prime importance. As turbulent flow is usual at full scale it is a main objective of model tests. For turbulent flow an important consideration is departure from equilibrium as, in these cases the similarity solutions so frequently used in calculations no longer apply. Including non-equilibrium effects in the velocity profile is particularly revealing, and is essential for determining the important scale parameters and establishing separation criteria. The turbulent boundary layer

is considered specifically in terms of the law of the wall and wake velocity profile which can be used to examine the influence of second order effects including that of departure from equilibrium.
Author

N88-28873# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
SHOCK BOUNDARY LAYER INTERACTION **c34**
E. Stanewsky *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 271-305 (For primary document see N88-28857 23-01)
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An essential prerequisite for the viscous simulation of the flow about transonic flight vehicles is the correct simulation of shock boundary layer interaction. The latter requires that the parameters of the incoming boundary layer dominating the interaction are known. An attempt is made to identify such parameters for the characteristic features of shock boundary layer interaction.
Author

N88-28874# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
CLASSICAL SEPARATION, TRAILING-EDGE FLOWS AND BUFFETING **c02**
J. L. vaningen *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 306-337 (For primary document see N88-28857 23-01)
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An overview of those aspects of classical separation, trailing-edge flows, and buffeting which are relevant to the simulation process is given. Viscous flow parameters which should be simulated are defined and some recommendations for further research are given.
Author

N88-28875# Calspan Field Services, Inc., Arnold AFS, Tenn.
VORTEX FLOWS **c34**
Edward M. Kraft *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 338-355 (For primary document see N88-28857 23-01)
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For today's high performance aircraft, separation and vortical flow is a fact of life. The design challenge is to control vortex separation and make it work to improve the aircraft performance. Vortical flows are generally complex and correspondingly difficult to model analytically. Consequently subscale simulation remains the primary developmental tool for vehicle optimization, particularly in a high speed maneuver. Therefore, it is essential to understand the physical aspects of vortical flows that effect subscale simulation. A brief summary of some of the key questions and current assessment is provided. The primary types of vortical flows of interests in terms of proper subscale simulation at transonic speeds are forebody vortices, wing leading edge vortex flows, vortex breakdown, and vortex/shock interactions. The fundamental aspects of these types of flow are explored and areas where further research is required, are suggested.
Author

N88-28876# Middle East Technical Univ., Ankara (Turkey). Dept. of Aeronautical Engineering.
ENVIRONMENTAL EFFECTS ON TRANSITION AND BOUNDARY LAYER CHARACTERISTICS **c34**
C. Ciray *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 356-408 (For primary document see N88-28857 23-01)
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The environmental effect on transition and some boundary layer characteristics is summarized. Environmental effects seem to be a section of fluid dynamics that was neglected or that was not studied systematically and in an organized manner. Yet with the need or increased accuracies required from recent wind tunnel measurements and the need for reduced discrepancies of the experimental data obtained from different wind tunnels, the wind tunnel environmental effects have to be accurately assessed. Looking at the breadth and delicacy both from an experimental and theoretical point of view, the subject of environmental effect on transition and boundary layer characteristics appears challenging and rewarding for fluid dynamicists.
Author

N88-28877# Calspan Field Services, Inc., Arnold AFS, Tenn.
BOUNDARY LAYER MANIPULATION **c34**
Edward M. Kraft *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 409-446 (For primary document see N88-28857 23-01)
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It is clear that, left to its own development, the boundary layer on a model used in a subscale simulation may have little resemblence, in general, to the boundary layer on the full-scale vehicle. Consequently, it is inevitable that some sort of manipulation of the viscous dominated regions on the model will have to be performed in order that the wind tunnel results can be extrapolated to flight. The elements necessary for a successful viscous simulation are: an understanding of what parameters need to be controlled in the subscale experiment to provide a surprise-free extrapolation to flight; means for manipulating and controlling the required viscous parameters. Methods for determining that the viscous parameters were properly controlled in the wind tunnel; and an understanding of how the wind tunnel data need to be extrapolated to flight from whatever conditions were established in the wind tunnel. It must also be kept in mind that different boundary layer manipulation techniques will be applied for different test requirements. In addition, different requirements may exist for various components of a vehicle. An overview of the elements required for boundary layer manipulation will be presented and some suggested areas for future research will be discussed.
Author

N88-28878# Naval Air Development Center, Warminster, Pa.
CLEANABILITY OF AIRCRAFT POLYURETHANE TOPCOATS
Phase Report, Oct. - Dec. 1987
Charles R. Hegedus and Donald J. Hirst Jan. 1988 40 p
(AD-A193456) Avail: NTIS HC A03/MF A01 CSCL 11C

U.S. Navy operational tactical aircraft are painted with a camouflage, two component, aliphatic polyurethane which is the product of hexamethylene diisocyanate and a polyester polyol. This material conforms to military specification MIL-C-83286. One deficiency of this coating which is frequently reported by field activities is its poor cleanability. Navy aircraft are repainted approximately every 3 to 4 years. During their deployment, they are soiled constantly and cleaned approximately every two weeks. The gray lusterless topcoats used in the camouflage schemes often cannot be restored to their original color, even with standard aircraft cleaners. In addition, when the discolored topcoat is damaged and must be repaired, matching of the color is impossible for field touch-up. A test to evaluate coating cleanability has been utilized to determine the severity of this problem and recommend possible solutions. Several coatings on the MIL-C-83286 qualified products list were evaluated along with topcoats which contain polymer bead pigments. A distinct correlation was found between cleanability and 60 deg gloss. Topcoats with a gloss of less than 4 had significant color changes when soiled and cleaned; coatings with gloss values above 4 had color changes that were far less noticeable even after 10 soiling/cleaning cycles.
GRA

N88-28879*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF INDEPENDENT VARIATION OF MACH AND REYNOLDS NUMBERS ON THE LOW-SPEED AERODYNAMIC CHARACTERISTICS OF THE NACA 0012 AIRFOIL SECTION
Charles L. Ladson Oct. 1988 97 p
(NASA-TM-4074; L-16472; NAS 1.15:4074) Avail: NTIS HC A05/MF A01 CSCL 01B

A comprehensive data base is given for the low speed aerodynamic characteristics of the NACA 0012 airfoil section. The Langley low-turbulence pressure tunnel is the facility used to obtain the data. Included in the report are the effects of Mach number and Reynolds number and transition fixing on the aerodynamic

characteristics. Presented are also comparisons of some of the results with previously published data and with theoretical estimates. The Mach number varied from 0.05 to 0.36. The Reynolds number, based on model chord, varied from 3 x 10 to the 6th to 12 x 10 to the 6th power. Author

N88-28880*# United Technologies Research Center, East Hartford, Conn.
AN UNSTEADY HELICOPTER ROTOR: FUSELAGE INTERACTION ANALYSIS Final Report
Peter F. Lorber and T. Alan Egolf Washington NASA Sep. 1988 123 p
(Contract NAS1-17469)
(NASA-CR-4178; NAS 1.26:4178; R88-956977-15) Avail: NTIS HC A06/MF A01 CSCL 01B

A computational method was developed to treat unsteady aerodynamic interactions between a helicopter rotor, wake, and fuselage and between the main and tail rotors. An existing lifting line prescribed wake rotor analysis and a source panel fuselage analysis were coupled and modified to predict unsteady fuselage surface pressures and airloads. A prescribed displacement technique is used to position the rotor wake about the fuselage. Either a rigid blade or an aeroelastic blade analysis may be used to establish rotor operating conditions. Sensitivity studies were performed to determine the influence of the wake fuselage geometry on the computation. Results are presented that describe the induced velocities, pressures, and airloads on the fuselage and on the rotor. The ability to treat arbitrary geometries is demonstrated using a simulated helicopter fuselage. The computational results are compared with fuselage surface pressure measurements at several locations. No experimental data was available to validate the primary product of the analysis: the vibratory airloads on the entire fuselage. A main rotor-tail rotor interaction analysis is also described, along with some hover and forward flight. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-28881*# Chrysler Corp., New Orleans, La. Military Public Electronic Systems.
SPACE SHUTTLE PHASE B WIND TUNNEL MODEL AND TEST INFORMATION. VOLUME 2: ORBITER CONFIGURATION
J. L. Glynn and D. E. Poucher Jul. 1988 457 p
(Contract NAS1-18276)
(NASA-CR-178415-Vol-2-Pt-1; NAS 1.26:178415-Vol-2-Pt-1; DMS-DB-02-Vol-2-Pt-1) Avail: NTIS HC A20/MF A01 CSCL 01A

Archived wind tunnel test data are available for flyback booster or other alternate recoverable configurations as well as reusable orbiters studied during initial development (Phase B) of the Space Shuttle. Considerable wind tunnel data was acquired by the competing contractors and the NASA centers for an extensive variety of configurations with an array of wing and body planforms. All contractor and NASA wind tunnel test data acquiredin the Phase B development have been compiled into a database and are available for applying to current winged flyback or recoverable booster aerodynamic studies. The Space Shuttle Phase B Wind Tunnel Database is structured by vehicle component and configuration type. Basic components include the booster, the orbiter, and the launch vehicle. Booster configuration types include straight and delta wings, canard, cylindrical, retroglide, and twin body. Orbiter configuration types include straight and delta wings, lifting body, drop tanks, and double delta wings. Launch configration types include booster and orbiter components in various stacked and tandom combinations. The digital database consists of 220 files of data containing basic tunnel recorded data. Author

N88-28882*# Texas A&M Univ., College Station.
INVESTIGATION OF HELICOPTER ROTOR BLADE/WAKE INTERACTIVE IMPULSIVE NOISE
S. J. Miley, G. F. Hall, and E. vonLavante Jan. 1987 117 p
(Contract NCA2-OR-773-301)
(NASA-CR-177435; NAS 1.26:177435) Avail: NTIS HC A06/MF A01 CSCL 01A

An analysis of the Tip Aerodynamic/Aeroacoustic Test (TAAT) data was performed to identify possible aerodynamic sources of blade/vortex interaction (BVI) impulsive noise. The identification is based on correlation of measured blade pressure time histories with predicted blade/vortex intersections for the flight condition(s) where impulsive noise was detected. Due to the location of the recording microphones, only noise signatures associated with the advancing blade were available, and the analysis was accordingly restricted to the first and second azimuthal quadrants. The results show that the blade tip region is operating transonically in the azimuthal range where previous BVI experiments indicated the impulsive noise to be. No individual blade/vortex encounter is identifiable in the pressure data; however, there is indication of multiple intersections in the roll-up region which could be the origin of the noise. Discrete blade/vortex encounters are indicated in the second quadrant; however, if impulsive noise were produced here, the directivity pattern would be such that it was not recorded by the microphones. It is demonstrated that the TAAT data base is a valuable resource in the investigation of rotor aerodynamic/aeroacoustic behavior. Author

N88-28883# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
NOISE GENERATION AND BOUNDARY LAYER EFFECTS IN VORTEX-AIRFOIL INTERACTION AND METHODS OF DIGITAL HOLOGRAM ANALYSIS FOR THESE FLOW FIELDS Interim Report No. 2, 28 Nov. 1987 - 28 Mar. 1988
G. E. Meier 31 Mar. 1988 10 p
(Contract DAJA45-87-C-0051)
(AD-A194191) Avail: NTIS HC A02/MF A01 CSCL 20D

For the generation of impulsive sound waves caused by parallel interaction of a vortex and an airfoil in a plane flow field, two different mechanisms are responsible by experimental evidence. The first one originates from the area of the stagnation point of the airfoil: a temporal increase of pressure and density - in consequence of the incoming vortex - relaxes by sound wave emission, when the vortex vanishes behind the airfoils nose. This is called a compressibility wave. The second one is reasoned by a supersonic flow regime, which appears, when the stationary airfoil flow is augmented by the flow field of the vortex: at the shoulder of the airfoil we get an unsteady return to subsonics by a shock wave. This moves upstream after the vortex has passed and is named transonic wave. Evidently both mechanisms only occur, if the flow field at the airfoil is augmented by the vortex, i.e., the vortex has a special spin orientation with respect to the airfoil. GRA

N88-28884# University of Southern California, Los Angeles. Dept. of Aerospace Engineering.
UNSTEADY WATER CHANNEL Final Report, Dec. 1984 - Dec. 1987
Chih-Ming Ho 29 Mar. 1988 15 p
(Grant AF-AFOSR-0064-85)
(AD-A194231; AFOSR-88-0466TR) Avail: NTIS HC A03/MF A01 CSCL 14B

When an airplane undergoes maneuvering, the motion includes many modes: pitching, plunging, translation, acceleration and deceleration. The aerodynamics of the first three types of motion are well-documented. The effects of acceleration and deceleration on the aerodynamic forces of a wing have not been explored in depth because a specially designed unsteady testing facility is necessary. The present water channel is able to provide a wide variety of free stream conditions. The test section of the water channel measures 18-in. by 18-in. and has a maximum flow rate of 3 ft/sec. In addition, a rotating gate provides programmable unsteady flow velocities. GRA

N88-28885# Maryland Univ., College Park. Dept. of Aerospace Engineering.
FELLOWSHIPS IN HYPERSONIC AERODYNAMICS Final Report, 1 Mar. 1983 - 31 Aug. 1986
John D. Anderson, Jr. Feb. 1988 48 p
(Contract DAAG29-83-G-0018)
(AD-A194265; ARO-20252.2-EG-F) Avail: NTIS HC A03/MF A01 CSCL 20D

This fellowship program supported two Ph.D. students in hypersonic aerodynamics. The research was carried out in two categories: The study of hypersonic waveriders, and the generation of a family of optimized waveriders including viscous effects; The numerical study of the interaction of a shock wave and a vortex at hypersonic speeds. Here, the calculations were made using a finite-volume technique with upwind differencing. GRA

N88-28886# Florida State Univ., Tallahassee. Fluid Mechanics Research Lab.
UNSTEADY FLOW PAST AN NACA 0012 AIRFOIL AT HIGH ANGLES OF ATTACK Technical Report, Jul. 1986 - Dec. 1987
A. Krothapalli, L. Lourenco, and L. VanDommelen 2 Mar. 1988 26 p
(Grant AF-AFOSR-0243-86)
(AD-A194650; FMRL-TR-2; AFOSR-88-0415TR) Avail: NTIS HC A03/MF A01 CSCL 01C

A whole field experimental technique, commonly referred to as Particle Image Velocimetry, was used for the measurement of the instantaneous two-dimensional velocity fields about an impulsively started NACA 0012 airfoil at high angles of attack. The velocity field was measured with sufficient accuracy, such that the time evolution of the vorticity field was obtained. The experiments were performed in a towing at a Reynolds number of 1400, based on the chord of the airfoil. For angles of attack greater than about 20 deg, the flow field at the upper surface of the airfoil show large scale vortical motions with the following time dependent scenario. At the initial stages of the airfoil startup, a separation bubble at the leading edge was generated and with time, it grows into an isolated primary vortex which dominated the whole flow field. Trailing behind this primary vortex were two counter rotating vortices. This multiple vortex structure grow together and move along the upper surface until it reaches the trailing edge. At this time, the primary vortex induces a trailing edge vortex. The primary and trailing edge vortices then form the wake flow field. GRA

N88-28887# Dayton Univ., Ohio. Research Inst.
AN INTEGRAL EQUATION FOR THE LINEARIZED UNSTEADY SUPERSONIC FLOW OVER A WING Final Report, May 1986 - Aug. 1987
Karl G. Guderley Dec. 1987 79 p
(Contract F33615-86-C-3200)
(AD-A193773; UDR-TR-87-95; AFWAL-TR-87-3107) Avail: NTIS HC A05/MF A01 CSCL 20D

This report derives an integral equation for the linearized supersonic unsteady potential flow over a wing. Every integral equation formulation for a problem that appears originally in the form of a partial differential equation presupposes the availability of a fundamental solution. Such a fundamental solution is available for the problem at hand in the literature. It is rederived here to show its particular properties. The integral equation originally obtained requires one to carry out a limiting process in which one approaches the planform from above or below. This formulation is brought into a form in which this limiting process no longer appears and one works solely with information available at the planform. Examples which can be treated analytically bring some properties which have a bearing on a numerical approach into sharper focus. GRA

N88-28888# Air Command and Staff Coll., Maxwell AFB, Ala.
A NUMERICAL STUDY OF THE TEST TIME IN A HYPERSONIC SHOCK TUNNEL
Robert E. Dillon, Jr. Apr. 1988 44 p
(AD-A194057; ACSC-88-0740) Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical study was made of the test time in a hypersonic shock tunnel for Mach 10 flow. Harten's total variation diminishing (TVD) scheme was used to simulate the entire shock tunnel operation from diaphragm rupture to disruption of the flow in the nozzle. The code was able to model the main features of unsteady flow in a shock tube to include the shock wave and contact surface intersections. Results were obtained that predict the steady flow duration time for stagnation temperatures of 1200 F, 2700 F, and 6900 F. Both air and helium were used as driver gases with air as the test gas. GRA

N88-28889# McDonnell-Douglas Research Labs., St. Louis, Mo.
THREE-DIMENSIONAL VORTEX INTERACTIONS Annual Technical Report, 1 Sep. 1986 - 31 Aug. 1987
Valdis Kibens, Richard W. Wlezien, Frederick W. Roos, and Jerome T. Kegelman 15 Jan. 1988 35 p
(Contract F49620-86-C-0090)
(AD-A194066; MDC-QA005; AFOSR-88-0484TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Three-dimensional vortex interactions were investigated in jets with slanted, indeterminate origin exit nozzles, and in mixing layers behind a splitter plate with a swept trailing edge. Flow visualization images were quantitatively processed to characterize complex three-dimensional vortex interactions in non axisymmetric jets. Phase conditioned pulsed laser sheet illumination was used to obtain a series of sectional images while rotating the asymmetric nozzle. The sectional images were recombined into an unwrapped representation of the developing vortex systems in the shear layer. Partial pairing of sections of adjacent vortex systems was shown to be responsible for asymmetric shear layer growth. Flow visualization in the flow behind the swept trailing edge showed that two families of instability waves can develop with different orientations with respect to the trailing edge angle. Excitation was shown to enhance waves with orientation parallel to the trailing edge or perpendicular to the mean flow direction, depending on excitation frequency. Streamwise wavelengths of the two wave families were related by their angular separation. GRA

N88-28890# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abteilung Verdichter.
THE INFLUENCE OF NUMERICAL BOUNDARY CONDITIONS ON TRANSONIC FLOW
Hannes Fogt Nov. 1987 66 p
(DFVLR-FB-88-06; ISSN-0171-1342; ETN-88-92924) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 25 Deutsche marks

In order to verify the different formulations for the Euler equations a program to calculate simple one-dimensional flow in a divergent tube is presented. A simple quasi-one-dimensional code was developed to calculate the steady state solution of the Euler equations by a time-marching method. Four different boundary condition algorithms for subsonic and supersonic flow were applied and the time-space development of the numerical results was examined. The post correction method lead to fast convergence with stable results without the need of considerable numerical smoothing. ESA

N88-28891*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
CALCULATION OF AERODYNAMIC CHARACTERISTICS OF AIRPLANE CONFIGURATIONS AT HIGH ANGLES OF ATTACK Final Report
J. B. Tseng and C. Edward Lan Oct. 1988 116 p
(Grant NAG1-635)
(NASA-CR-4182; NAS 1.26:4182; CRINC-FRL-730-1) Avail: NTIS HC A06/MF A01 CSCL 01A

Calculation of longitudinal and lateral directional aerodynamic characteristics of airplanes by the VORSTAB code is examined. The numerical predictions are based on the potential flow theory with corrections of high angle of attack phenomena; namely, vortex

flow and boundary layer separation effects. To account for the vortex flow effect, vortex lift, vortex action point, augmented vortex lift and vortex breakdown effect through the method of suction analogy are included. The effect of boundary layer separation is obtained by matching the nonlinear section data with the three dimensional lift characteristics iteratively. Through correlation with results for nine fighter configurations, it is concluded that reasonably accurate prediction of longitudinal and static lateral directional aerodynamics can be obtained with the VORSTAB code up to an angle of attack at which wake interference and forebody vortex effect are not important. Possible reasons for discrepancy at higher angles of attack are discussed. Author

N88-28892*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACCURATE SOLUTIONS, PARAMETER STUDIES AND COMPARISONS FOR THE EULER AND POTENTIAL FLOW EQUATIONS
W. Kyle Anderson and John T. Batina Sep. 1988 18 p Presented at the AGARD 62nd Meeting of the Fluid Dynamics Panel Symposium on Validation of Computational Fluid Dynamics, Lisbon, Portugal, 2-5 May 1988
(NASA-TM-100664; NAS 1.15:100664) Avail: NTIS HC A03/MF A01 CSCL 01A

Parameter studies are conducted using the Euler and potential flow equation models for unsteady and steady flows in both two and three dimensions. The Euler code is an implicit, upwind, finite volume code which uses the Van Leer method of flux-vector-splitting which has been recently extended for use on dynamic meshes and maintain all the properties of the original splitting. The potential flow code is an implicit, finite difference method for solving the transonic small disturbance equations and incorporates both entropy and vorticity corrections into the solution procedures thereby extending its applicability into regimes where shock strength normally precludes its use. Parameter studies resulting in benchmark type calculations include the effects of spatial and temporal refinement, spatial order of accuracy, far field boundary conditions for steady flow, frequency of oscillation, and the use of subiterations at each time step to reduce linearization and factorization errors. Comparisons between Euler and potential flows results are made as well as with experimental data where available. Author

N88-28893# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AERODYNAMIC DATA ACCURACY AND QUALITY: REQUIREMENTS AND CAPABILITIES IN WIND TUNNEL TESTING
Marion L. Laster (Arnold Engineering Development Center, Arnold Air Force Station, Tenn.) Jul. 1988 13 p Presented at the AGARD Fluid Dynamics Panel Symposium, Naples, Italy, 28 Sep. - 1 Oct. 1987
(AGARD-AR-254; ISBN-92-835-0468-2) Copyright Avail: NTIS HC A03/MF A01

This report presents a technical evaluation and assessment of the AGARD Fluid Dynamics Panel Symposium on Aerodynamic Data Accuracy and Quality; Requirements and Capabilities in Wind Tunnel Testing, held in September 1987 in Naples, Italy. The major issues addressed were: what data acuracy is needed by users; what accuracy is presently achieved; and what can be done to improve the situation? Users have asked that cruise drag be measured to a precision of one drag count for transports and two for military fighters; it was shown that this is possible when reference methods can be used. However, one or two drag count uncertainty is not state-of-the-art for the direct scaling concept and improvement will require a thorough understanding of all these parameters which significantly contribute to wind tunnel uncertainty, including bias and precision. A reduction in total uncertainty appears possible but a reduction to a level of one or two drag count also appears formidable. Author

N88-28894*# Boeing Commercial Airplane Co., Seattle, Wash.
VARIABLE SWEEP TRANSITION FLIGHT EXPERIMENT (VSTFE)-PARAMETRIC PRESSURE DISTRIBUTION BOUNDARY LAYER STABILITY STUDY AND WING GLOVE DESIGN TASK Contractor Report, Feb. 1983 - Nov. 1984
Rodger A. Rozendaal Washington, D.C. Jun. 1986 167 p (Contract NAS1-15325)
(NASA-CR-3992; NAS 1.26:3992; D6-52511) Avail: NTIS HC A08/MF A01 CSCL 01A

The Variable Sweep Transition Flight Experiment (VSTFE) was initiated to establish a boundary-layer transition data base for laminar flow wing design. For this experiment, full-span upper-surface gloves will be fitted to a variable sweep F-14 aircraft. The results of two initial tasks are documented: a parametric pressure distribution/boundary-layer stability study and the design of an upper-surface glove for Mach 0.8. The first task was conducted to provide a data base from which wing-glove pressure distributions could be selected for glove designs. Boundary-layer stability analyses were conducted on a set of pressure distributions for various wing sweep angles, Mach numbers, and Reynolds number in the range of those anticipated for the flight-test program. The design procedure for the Mach 0.8 glove is described, and boundary-layer stability calculations and pressure distributions are presented both at design and off-design conditions. Also included is the analysis of the clean-up glove (smoothed basic wing) that will be flight-tested initially and the analysis of a Mach 0.7 glove designed at the NASA Langley Research Center. Author

N88-28895*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STEADY AND UNSTEADY TRANSONIC PRESSURE MEASUREMENTS ON A CLIPPED DELTA WING FOR PITCHING AND CONTROL-SURFACE OSCILLATIONS
Robert W. Hess, F. W. Cazier, Jr., and Eleanor C. Wynne Washington, D.C. Oct. 1986 118 p MF as supplement
(NASA-TP-2594; L-16082; NAS 1.60:2594) Avail: NTIS HC A06/MF A01 CSCL 01A

Steady and unsteady pressures were measured on a clipped delta wing with a 6-percent circular-arc airfoil section and a leading-edge sweep angle of 50.40 deg. The model was oscillated in pitch and had an oscillating trailing-edge control surface. Measurements were concentrated over a Mach number range from 0.88 to 0.94; less extensive measurements were made at Mach numbers of 0.40, 0.96, and 1.12. The Reynolds number based on mean chord was approximately 10 x 10 to the 6th power. The interaction of wing or control-surface deflection with the formation of shock waves and with a leading-edge vortex generated complex pressure distributions that were sensitive to frequency and to small changes in Mach number at transonic speeds. Author

N88-28860# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Civil Transport Aircraft Div.
DELTA WING CONFIGURATIONS
J. Szodruch *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 30-49 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28869# Potter (J. Leith), Nashville, Tenn.
MISSILES, FUSELAGES AND SIMILAR BODIES
J. Leith Potter *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 191-208 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28870# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
INTRODUCTION AND CRITICAL FLOW PHENOMENA
E. Stanewsky *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 211-216 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28871# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
BOUNDARY LAYER DEVELOPMENT AND TRANSITION
Roger Michel *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 217-249 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28874# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
CLASSICAL SEPARATION, TRAILING-EDGE FLOWS AND BUFFETING
J. L. vaningen *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 306-337 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-28896*# Nevada Univ., Reno. Engineering Research and Development Center.
AERODYNAMICS OF SEEING ON LARGE TRANSPORT AIRCRAFT Final Technical Report, 1 Dec. 1985 - 30 Nov. 1986
William C. Rose 15 Aug. 1988 4 p
(Contract NCC2-382)
(NASA-CR-183122; NAS 1.26:183122) Avail: NTIS HC A02/MF A01 CSCL 01C

Efforts were undertaken to obtain a set of data that examined the level of turbulence and the scale sizes in the shear layer existing over the fence quieted cavity on the NASA-Ames Kuiper Airborne Observatory (KAO). These data were to be taken during the present study and compared with data taken from previous wind tunnel experiments, for which both aerodynamic and direct optical measurements were made. The data obtained during the present study were presented and discussed in light of their impact on the quality of optical images, that is, seeing through the shear layer. In addition, scaling relationships were presented that allow optical data obtained in one aerodynamic environment to be estimated for another one at perhaps different Mach numbers, scale sizes, or aircraft configurations. Author

N88-28897# Air Command and Staff Coll., Maxwell AFB, Ala.
FLIGHT INFORMATION PUBLICATION (FLIP) FEEDBACK M.S. Thesis
Charles L. McGaugh, Jr. Apr. 1988 40 p
(AD-A194462; ACSC-88-1755) Avail: NTIS HC A03/MF A01 CSCL 05B

This report investigates the USAF feedback system for Flight Information Publications, commonly referred to as FLIP. The primary focus of this research project analyzes the usage of the Defense Mapping Agency Quality Feedback Card as a method for aviators to submit recommendations to improve FLIPs. This project studies the past use of the feedback card, current opinions of aviators attending Air Command Staff College, Class of 1988, and the principle Office of Primary Responsibility for the USAF feedback system. The concluding remarks provide recommendations to enhance the USAF FLIP feedback system. Emphasis is placed on increasing the interaction between customers and producers. GRA

N88-28898 Civil Aviation Authority, London (England).
SMOKE HOODS: NET SAFETY BENEFIT ANALYSIS
Nov. 1987 25 p
(CAA-Paper-87017; ISBN-0-86-039330-5; ETN-88-92653)
Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, United Kingdom 7 pounds

The benefits to airline passengers of smoke hoods were assessed by studying past accidents. It is concluded that the provision of effective passenger smoke hoods in public transport aircraft of more than 30 seats would result in a modest saving of life. The analysis shows that the saving expected is of the order of 9 fire related deaths per year world-wide if the accident/fire history of the past 20 yr is broadly repeated. This total would be massively reduced if credit is taken for lavatory fire precautions in the VARIG B707 near Orly (France) in 1973. The analysis also shows that even if the wearing of smoke hoods results in a delayed or slower evacuation, the net benefit remains positive, but reduced. ESA

N88-28899# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Bauweisen und Konstruktionsforschung.
CRASH SIMULATION CALCULATIONS AND COMPONENT IDEALIZATION FOR AN AIRFRAME. COMPUTER CODE KRASH 79 [CRASHSIMULATIONSRECHNUNGEN UND BAUTEILIDEALISIERUNG FUER EINEN FLUGZEUGUNTERBODEN. RECHENCODE KRASH 79]
Wolfgang G. Hienstorfer 28 Jan. 1987 164 p In GERMAN
(ETN-88-92971) Avail: NTIS HC A08/MF A01

A metal airframe of an aircraft of the weight class 3T was investigated in crash cases with a mainly vertical impact component using the simulation program KRASH 79. The results of the simulation calculations are shown in the form of acceleration/time evolutions of the discretized masses of the idealized structure and of structural displacements in the frame. The deformation behavior of a given seat structure was determined, and the dynamic-response index allows one to predict back injuries. Configuration-typical force/displacement characteristics under axial pressure loading were obtained in dimensionless form, allowing the determination of the dynamic response of the airframe. ESA

N88-28900*# National Aeronautics and Space Administration, Washington, D.C.
CONTRIBUTIONS TO THE MODELING OF WIND SHEAR FOR DANGER STUDIES
Manfred Swolinsky Sep. 1988 190 p Transl. into ENGLISH of Beitraege zur Modellierung von Scherwind fuer Gefaehrdungsuntersuchungen (Brunswick, Fed. Republic of Germany, Technischen Univ. Carolo-Wilhelmina), Apr. 1986 200 p Original language document was announced as N88-10463 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20293; NAS 1.77:20293) Avail: NTIS HC A09/MF A01 CSCL 01C

Wind models for flight simulation and the study of the danger during landing due to wind shear were developed. It is demonstrated that the typical wind conditions in weather phenomena such as thunderstorm downdrafts and surface boundary layer wind shear can be approximated by simple engineeringf models, whereby known solutions and flow forms from flow mechanics were adapted. The good agreement between models and airborne measurements is demonstrated. Based on the developed models the degree of danger during landing under different wind shear conditions was estimated. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-28901# Naval Postgraduate School, Monterey, Calif.
ESTIMATION FORCES ACTING ON AN UNDERWATER VEHICLE WITH G.P.S. (GLOBAL POSITIONING SYSTEM) AND KALMAN FILTERING M.S. Thesis
James K. Easton, Jr. Mar. 1988 64 p
(AD-A194339) Avail: NTIS HC A04/MF A01 CSCL 13J

A discrete state space model is developed which describes an autonomous underwater vehicle and incorporates the effects of currents, sea state, and wind as it travels through the sea. Heading commands are calculated to overcome these effects by the design of an Extended Kalman Filter which estimates their combined velocity components. Simulations are done which test the filter's effectiveness in a range of different environments. Some potential uses for this system are also discussed. GRA

N88-28902# Coast Guard, Alexandria, Va. Omega Navigation System Center.
INDIAN OCEAN VALIDATION
E. R. Swanson and C. P. Kugel 1 Sep. 1987 179 p
(AD-A194458; USCG-ONSCEN-02-87) Avail: NTIS HC A09/MF A01 CSCL 17G

Results from the Indian Ocean validation conducted during 1983 are presented. Existing coverage theories were largely confirmed in the region except that an interference boundary for the use of Japan at night in Western Australia should be relocated. The supported coverage theories indicate potential accuracy of 2 nmi (c.e.p) or better throughout the region on a 24-hour basis except in the important trade route from the Red Sea, around the tip of India, through the Straits of Malacca, and into the South China Sea. On the trade routes accuracies as poor as five miles may occasionally occur. GRA

N88-28903# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PERFORMANCE OF GPS-AIDED INS DURING HIGH-DYNAMIC MANEUVERS M.S. Thesis
Joseph R. Cunningham Dec. 1987 131 p
(AD-A194624; AFIT/GE/ENG/87D-12) Avail: NTIS HC A07/MF A01 CSCL 17G

The unstable characteristic of an integrated Inertial Navigation System (INS) and Global Positioning System (GPS) receiver is explored. During high-dynamic maneuvers, the INS Kalman filter provides velocity estimates to the GPS receiver code loop in an attempt to remove Doppler-induced tracking errors. The GPS receiver Kalman filter, in turn, provides position and velocity estimates to correct INS errors. Due to the suboptimal nature of the two individual filters, this closed-loop process neglects key elements of information: time and spatial correlation. Therefore, this closed-loop system quickly becomes unstable during high-dynamic maneuvers, resulting in degraded navigational performance. Truth models of the INS and GPS receiver are developed. Kalman filters based on these two models are combined to yield a joint-solution model Kalman filter which serves as an indication of the best structure of integration possible. The eigenvalues of the basic INS error dynamics model, when subjected to various dynamic scenarios, are examined. A candidate maneuver is selected to compare the performance of five systems: the INS truth model, the joint solution model, the GPS receiver truth model, the joint solution model, a two-filter system containing the INS and GPS receiver truth models, and a two-filter system containing reduced-order models of the INS and GPS receiver indicative of current system configuration. GRA

N88-28904# Army Engineer Topographic Labs., Fort Belvoir, Va.
A COMPARISON: STATIC AND FUTURE KINEMATIC GPS (GLOBAL POSITIONING SYSTEM) SURVEYS
Kevin P. Logan 27 Apr. 1988 21 p
(AD-A194666; ETL-R-137) Avail: NTIS HC A03/MF A01 CSCL 17G

A three-year program was begun to introduce the use of Global Positioning Systems (GPS) technology to all U.S. Army Corps of Engineers Districts and Divisions as a means of performing geodetic surveys. Through this program, district survey personnel have the opportunity to participate in a survey project of the district's choice. Six GPS receivers were purchased to be used in a series of demonstrations in this program. Both during and after each demonstration, feedback is being given by district personnel on items such as how field operations could be changed, how the equipment could be modified to make it more user friendly, and most importantly, how GPS could be applied to assist them in performing their survey mission. Although relative static GPS offers a substantial improvement over the way many conventional surveys are performed, district personnel indicated that many applications are not feasible at present because of the time needed to conduct observations at each monument. Since 1985, there has been growing interest in reducing the observation time required to perform geodetic surveys with GPS. One method of reducing the observation time is a technique referred to as relative kinematic surveying. This paper will examine the techniques of relative static and relative kinematic surveying and discuss the benefits of each. Examples of applications in which each technique could prove beneficial for the Corps surveyor, such as dam monitoring, will be presented. GRA

N88-28905# Universitaet der Bundeswehr, Neubiberg (West Germany). Fakultaet fuer Luft- und Raumfahrttechnik.
AUTOMATIC LANDING BY COMPUTER VISION Ph.D. Thesis [AUTOMATISCHER LANDEANFLUG DURCH RECHNERSEHEN]
Guenter Eberl 1987 163 p In GERMAN
(ETN-88-92991) Avail: NTIS HC A08/MF A01

Automatic landing control is performed by remote image processing via a hierarchic structured computer system where all flight motion degrees of freedom are individually controlled. A concept for automatic landing by computer vision is developed and tested in computer simulation conditions. Special image processing and hardware permits real time treatment of landing area geometry, perspective transformations, and dynamic aircraft motion modeling. Analysis of real landing operation demonstrates that data acquisition is valuable not only in laboratory conditions. ESA

N88-28906# Royal Signals and Radar Establishment, Malvern (England).
FINE RESOLUTION ERRORS IN SECONDARY SURVEILLANCE RADAR ALTITUDE REPORTING
D. B. Jenkins, B. A. Wyndham, and P. Banks Jan. 1988 45 p
Sponsored by the Civil Aviation Authority, London, United Kingdom
(RSRE-87019; BR106199; ETN-88-93137) Copyright Avail: NTIS HC A03/MF A01

Faults in the three C bits used to encode the fine resolution part of the secondary surveillance radar (SSR) pressure altitude message, for use in airborne collision avoidance systems, were investigated for aircraft using UK airspace and transmitting SSR Mode A Identification Codes other than the Conspicuity Codes 4321 and 4322. Of 132,773 aircraft trajectories investigated, 581 trajectories, involving at least 68 aircraft, exhibit a C bit fault, a frequency of occurrence of 0.44 percent. On the basis of SSR Mode A Identification Code, aircraft in a sample of 44,191 trajectories were identified and examined separately involving those undertaking international flights under civil air traffic control (ATC), those undertaking domestic flights under civil ATC, those receiving a service from military ATC, and those transmitting codes issued by airport approach ATC. The frequency of C bit faults varies significantly according to the type of flight, and is particularly high

among aircraft transmitting approach codes, suggesting that the overall frequency found in any given volume of airspace depends on the types of flight undertaken in that airspace, and might be high in the vicinity of airport approaches. ESA

N88-28907 Civil Aviation Authority, London (England).
UK AIRMISSES INVOLVING COMMERCIAL AIR TRANSPORT
Apr. 1988 66 p
(CAA-1/88; ISSN-0951-6301; ETN-88-93146) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, United Kingdom

Airmiss statistics from 1977 to Aug. 1987 for United Kingdom airspace are presented. Reports of incidents are summarized. ESA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation*.

N88-28908# Conrad Technologies, Inc., King of Prussia, Pa.
STRUCTURAL DYNAMICS OF MANEUVERING AIRCRAFT
Final Report, Jul. 1986 - Sep. 1987
M. M. Reddi Sep. 1987 90 p
(Contract N62269-86-C-0278)
(AD-A192376; CTI-8601; NADC-88014-60) Avail: NTIS HC A05/MF A01 CSCL 20K

The technical objectives of the research are to establish the minimum level of modeling necessary for predicting the dynamic stresses in fighter aircraft during maneuvers and transitions between maneuvers, to identify the physical phenomena which are significant, to identify potential shortfalls in current aircraft design technology and to identify areas for further research. A symmetric wing, modeled as a beam with quasi-steady aerodynamic loads introduced through the vortex lattice method, is used for the dynamic evaluation. The dynamical equations of motion are solved in the time domain by the Runge-Kutta method specialized to second order equations. The maneuver dynamic analysis program, MANDYN, written in FORTRAN 77, uses the parameters of real variable-geometry airplane. An extensive investigation of dynamic loads resulting from a simple maneuver for various severity levels revealed that the lowest natural frequency and load application time are significant factors in determining the validity of the load factor approach. Recommendations based on the study results are made. GRA

N88-28909# Air Command and Staff Coll., Maxwell AFB, Ala.
INFLIGHT REARMING
Michael W. Cole Apr. 1988 37 p
(AD-A193564; ACSC-88-570) Avail: NTIS HC A03/MF A01 CSCL 01B

A new way is proposed for NATO and U.S. forces to counter the growing Soviet conventional advantage in Europe. The proposal is an Inflight Rearming Aircraft capable of rearming combat aircraft similar to the way they're refueled in flight. In the past, NATO has relied on technological superiority to offset Soviet numerical advantages but that gap is narrowing fast. Therefore, NATO must continue to investigate new ways to maintain any technical edge it can. Central to any Soviet attack on the West will be the role played by Operational Maneuver Groups (OMG) which are characterized by speed and depth of penetration. These OMG's are characteristic of the blitzkrieg approach the Soviets will launch against NATO. Additionally, they symbolize just what NATO cannot afford to lose; NATO can't trade space for time as the Soviets did in WWII. Therefore, a system such as a rearming aircraft can keep aircraft at the front longer to maintain an offensive or give continuous support to a defensive position. Today's Airland battle allows for emerging technologies to fit into any future plans. Inflight rearming will allow aircraft to be refitted close to the front. Another development of a rearming aircraft might be a hybrid design combining both refueling and rearming capabilities in a single aircraft. Such a plane, whether hybrid or not, would contribute significantly as a force multiplier to any conventional force. GRA

N88-28910# Air Command and Staff Coll., Maxwell AFB, Ala.
LOW ALTITUDE: A NEW DIMENSION IN AIR REFUELING
Cary M. Walgamott Apr. 1988 34 p
(AD-A193819; ACSC-88-2690) Avail: NTIS HC A03/MF A01 CSCL 01B

Enemy air defenses have increased their sophistication due to technological advancements. Response to these advancements requires new tactics and procedures to increase the B-52's chances of penetrating such air defenses. One such possible tactic is low altitude air refueling (LAAR). This article examines the need for LAAR and assesses the U.S. Air Forces's ability to satisfy that need. Capabilities of the U.S. military's air refueling aircraft are analyzed. The effects of low altitude flight on the KC-135's airframe, autopilot, navigation systems, and aircraft performance are examined. Finally the article discusses the degree to which LAAR missions impact on operational and maintenance organizations so tasked. GRA

N88-28911# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Mathematische Verfahren und Datentechnik.
ESTIMATION OF AIRCRAFT PARAMETERS USING FILTER ERROR METHODS AND EXTENDED KALMAN FILTER
Ravindra Jategaonkar (Technische Univ., Brunswick, West Germany) and Ermin Plaetschke Mar. 1988 59 p
(DFVLR-FB-88-15; ISSN-0171-1342; ETN-88-92933) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 23 Deutsche marks

Four algorithms for parameter estimation in linear and nonlinear systems accounting for process and measurement noise using two different approaches, namely direct approach and filtering approach, are compared. In the direct approach the iterative Gauss-Newton method incorporating a suitable state estimator is used to estimate the unknown parameters by optimization of the likelihood function. For the state estimation both time-varying and steady-state filters are used. In the filtering approach the unknown parameters are estimated as augmented states using the extended Kalman filter. The estimation results from three model postulates, one linear and two nonlinear, to extract aircraft derivatives from simulated and flight test data are used for comparison. Aspects such as convergence, computational time, parameter estimates and their accuracies are evaluated for each of the four estimation algorithms. ESA

N88-28912# Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
A CONTRIBUTION TO THE QUANTITATIVE ANALYSIS OF THE INFLUENCE OF DESIGN PARAMETERS ON THE OPTIMAL DESIGN OF PASSENGER AIRCRAFT Ph.D. Thesis [EIN BEITRAG ZUR QUANTITATIVEN ANALYSE DES EINFLUSSES VON AUSLEGUNGSPARAMETERN AUF DEN OPTIMALEN ENTWURF VON VERKEHRSELUGZEUGEN]
Hans-Wilhelm Pohl 1987 160 p In GERMAN
(ETN-88-92979) Avail: NTIS HC A08/MF A01

The dependencies of passenger aircraft design parameters on several factors were analyzed, with emphasis on the effects of fuel price increases. With a view to optimization calculations a two-phase program system for the aircraft was developed; it is represented in the form of timing charts. The first part of the program pre-optimizes a large number of design parameters, performs sensitivity studies, and indentifies side-minima. The results are used as initial values in the second part of the program to determine the optimized design with substantially better precision. The optimization programs determine the effects of external boundary conditions on the design. The effects of fuel costs and capital costs on the optimum design are presented. ESA

N88-28913# European Space Agency, Paris (France).
ADDITIONAL INVESTIGATIONS INTO THE AIRCRAFT LANDING PROCESS: TEST DISTRIBUTIONS
Hanns-Juergen Peters (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, West Germany) Jun. 1988 74 p Transl. into ENGLISH of Erganzende Untersuchungen zum Landeprozess von Flugzeugen - Testverteilungen, Cologne, Federal Rep. of West Germany (DFVLR) Original language document was announced as N88-16686
(ESA-TT-1099; DFVLR-Mitt-87-13; ETN-88-93055) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 25.50 deutsche marks

The landing times for the 10 German civil airports, without waiting times due to aircraft allocations to holding areas, were investigated using a simulation model for the landing process. Test distributions were developed. Results are synthetic landing time distributions with waiting times, the adaptation of which to the empirical landing time distribution was evaluated using the Chi-square test. Further improvements of the adaptation of the simulated distribution to the empirical one can be obtained by structural changes of the test distribution, e.g., by limitation of the maximum landing time. ESA

N88-28914* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGH PERFORMANCE FORWARD SWEPT WING AIRCRAFT Patent
David G. Koenig, inventor (to NASA), Kiyoshi Aoyagi, inventor (to NASA), Michael R. Dudley, inventor (to NASA), and Susan B. Schmidt, inventor (to NASA) 30 Aug. 1988 14 p Filed 24 Nov. 1986 Supersedes N87-18561 (25 - 11, p 1439)
(NASA-Case-ARC-11636-1; US-Patent-4,767,083; US-Patent-Appl-SN-933963; US-Patent-Class-244-12.3; US-Patent-Class-244-12.4; US-Patent-Class-244-207; US-Patent-Class-244-45-A; US-Patent-Class-244-55) Avail: US Patent and Trademark Office CSCL 01C

A high performance aircraft capable of subsonic, transonic and supersonic speeds employs a forward swept wing planform and at least one first and second solution ejector located on the inboard section of the wing. A high degree of flow control on the inboard sections of the wing is achieved along with improved maneuverability and control of pitch, roll and yaw. Lift loss is delayed to higher angles of attack than in conventional aircraft. In one embodiment the ejectors may be advantageously positioned spanwise on the wing while the ductwork is kept to a minimum.
Official Gazette of the U.S. Patent and Trademark Office

N88-28915*# Douglas Aircraft Co., Inc., Long Beach, Calif.
CRITICAL JOINTS IN LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES. VOLUME 2: TECHNOLOGY DEMONSTRATION TEST REPORT
Bruce L. Bunin Jun. 1985 209 p
(Contract NAS1-16857)
(NASA-CR-172587; NAS 1.26:172587; ACEE-26-TR-3478-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 01C

A program was conducted to develop the technology for critical structural joints in composite wing structure that meets all the design requirements of a 1990 commercial transport aircraft. The results of four large composite multirow bolted joint tests are presented. The tests were conducted to demonstrate the technology for critical joints in highly loaded composite structure and to verify the analytical methods that were developed throughout the program. The test consisted of a wing skin-stringer transition specimen representing a stringer runout and skin splice on the wing lower surface at the side of the fuselage attachment. All tests were static tension tests. The composite material was Toray T-300 fiber with Ciba-Geigy 914 resin in 10 mil tape form. The splice members were metallic, using combinations of aluminum and titanium. Discussions are given of the test article, instrumentation, test setup, test procedures, and test results for each of the four specimens. Some of the analytical predictions are also included. Author

N88-28916*# Douglas Aircraft Co., Inc., Long Beach, Calif.
CRITICAL JOINTS IN LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES. VOLUME 3: ANCILLARY TEST RESULTS
Bruce L. Bunin and R. L. Sagui Washington, D.C. Jun. 1985 338 p
(Contract NAS1-16857)
(NASA-CR-172588; NAS 1.26:172588; ACEE-26-TR-3958A-Vol-3) Avail: NTIS HC A15/MF A01 CSCL 01C

A program was conducted to develop the technology for critical structural joints for composite wing structure that meets all the design requirements of a 1990 commercial transport aircraft. The results of a comprehensive ancillary test program are summarized, consisting of single-bolt composite joint specimens tested in a variety of configurations. These tests were conducted to characterize the strength and load deflection properties that are required for multirow joint analysis. The composite material was Toray 300 fiber and Ciba-Geigy 914 resin, in the form of 0.005 and 0.01 inch thick unidirectional tape. Tests were conducted in single and double shear for loaded and unloaded hole configurations under both tensile and compressive loading. Two different layup patterns were examined. All tests were conducted at room temperature. In addition, the results of NASA Standard Toughness Test (NASA RP 1092) are reported, which were conducted for several material systems. Author

N88-28917*# Boeing Military Airplane Development, Wichita, Kans.
MULTIPLE-PURPOSE SUBSONIC NAVAL AIRCRAFT (MPSNA): MULTIPLE APPLICATION PROPFAN STUDY (MAPS) Final Report
R. M. Engelbeck, C. T. Havey, A. Klamka, C. L. McNeil, and M. A. Paige Sep. 1986 219 p
(Contract NAS3-24529)
(NASA-CR-175104; NAS 1.26:175104; D500-11313-1) Avail: NTIS HC A10/MF A01 CSCL 01C

Study requirements, assumptions and guidelines were identified regarding carrier suitability, aircraft missions, technology availability, and propulsion considerations. Conceptual designs were executed for two missions, a full multimission aircraft and a minimum mission aircraft using three different propulsion systems, the UnDucted Fan (UDF), the Propfan and an advanced Turbofan. Detailed aircraft optimization was completed on those configurations yielding gross weight performance and carrier spot factors. Propfan STOVL conceptual designs were exercised also to show the effects of STOVL on gross weight, spot factor and cost. An advanced technology research plan was generated to identify additional investigation opportunities from an airframe contractors standpoint. Life cycle cost analysis was accomplished yielding a comparison of the UDF and propfan configurations against each other as well as against a turbofan with equivalent state of the art turbo-machinery. Author

N88-28918*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TEST RESULTS AT TRANSONIC SPEEDS ON A CONTOURED OVER-THE-WING PROPFAN MODEL
Alan D. Levin, Donald B. Smeltzer, and Ronald C. Smith Jul. 1986 98 p
(NASA-TM-88206; A-86082; NAS 1.15:88206) Avail: NTIS HC A05/MF A01 CSCL 01C

A semispan wing/body model with a powered highly loaded propeller has been tested to provide data on the propulsion installation drag of advanced propfan-powered aircraft. The model had a supercritical wing with a contoured over-the-wing nacelle. It was tested in the Ames Research Center's (ARC) 14-foot Transonic Wind Tunnel at a total pressure of 1 atm. The test was conducted at angles of attack from -0.5 to 4 deg at Mach numbers ranging from 0.6 to 0.8. The test objectives were to determine propeller performance, exhaust jet effects, propeller slipstream interference drag, and total powerplant installation drag. Test results indicated a total powerplant installation drag of 82 counts (0.0082) at a

Mach number of 0.8 and a lift coefficient of 0.5, which is approximately 29 percent of a typical airplane cruise drag.
Author

N88-28867# Aircraft Research Association Ltd., Bedford (England).
TRANSPORT-TYPE CONFIGURATIONS
A. B. Haines and A. Elsenaar (National Aerospace Lab., Amsterdam, Netherlands) *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 139-163 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28868# Aircraft Research Association Ltd., Bedford (England).
COMBAT AIRCRAFT
A. B. Haines *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 164-190 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-28919*# CK Consultants, Inc., Mariposa, Calif.
AVIONICS SYSTEM DESIGN FOR HIGH ENERGY FIELDS: A GUIDE FOR THE DESIGNER AND AIRWORTHINESS SPECIALIST Final Report
Roger A. McConnell Jun. 1987 235 p
(Contract NAS2-12448)
(NASA-CR-181590; NAS 1.26:181590; DOT/FAA/CT-87/19)
Avail: NTIS HC A11/MF A01 CSCL 01D

Because of the significant differences in transient susceptibility, the use of digital electronics in flight critical systems, and the reduced shielding effects of composite materials, there is a definite need to define pracitices which will minimize electromagnetic susceptibility, to investigate the operational environment, and to develop appropriate testing methods for flight critical systems. The design practices which will lead to reduced electromagnetic susceptibility of avionics systems in high energy fields is described. The levels of emission that can be anticipated from generic digital devices. It is assumed that as data processing equipment becomes an ever larger part of the avionics package, the construction methods of the data processing industry will increasingly carry over into aircraft. In Appendix 1 tentative revisions to RTCA DO-160B, Environmental Conditions and Test Procedures for Airborne Equipment, are presented. These revisions are intended to safeguard flight critical systems from the effects of high energy electromagnetic fields. A very extensive and useful bibliography on both electromagnetic compatibility and avionics issues is included. Author

N88-28920# Air Command and Staff Coll., Maxwell AFB, Ala.
COMPUTERS IN WEAPONS SYSTEMS: A LOOK AT THE F-15 M.S. Thesis
Michael W. Pinter Apr. 1988 28 p
(AD-A194498; ACSC-88-2135) Avail: NTIS HC A03/MF A01 CSCL 01C

The advance in computer technology has allowed more memory and processing capacity in smaller, more reliable packages. Modern weapons systems are requiring this extra computer memory and processing capacity to succeed on the modern battlefield. This report uses the F-15 aircraft as an example of the computer memory and processing capacity growth in a modern weapons system. The same growth can be expected to continue in the next generation of fighter aircraft. This report also looks at selected F-15 software update management procedures to make recommendations on how to produce more timely, better quality software updates. This report reviews the growing importance of computers in modern weapons systems. It also looks at the computer memory and processing capacity growth experienced in the F-15 radar and central computer. Future tactical aircraft weapons systems can be expected to experience similar growth. However, advancing computer technology may allow significant spare memory and processing capacity to be available for incorporation into next generation fighter aircraft. Therefore, proper planning for spare memory and computer costly computer hardware upgrades to these systems. Finally, this report examines current F-15 software update management procedures. GRA

N88-28921# Crew Systems Consultants, Yellow Springs, Ohio.
IMPROVEMENT OF HEAD-UP DISPLAY STANDARDS. VOLUME 2: EVALUATION OF HEAD-UP DISPLAYS TO ENHANCE UNUSUAL ATTITUDE RECOVERY Final Report, 1 Oct. 1984 - 15 Jun. 1987
Richard L. Newman Sep. 1987 61 p
(Contract F33615-85-C-3602)
(AD-A194601; TR-87-14; AFWAL-TR-87-3055-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 25C

Several variations of head-up display symbologies were evaluated in a fixed base simulator to study their effect on unusual attitude recovery using head-up display data alone. The results indicate that pitch scale compression, additional bank information, and slanted pitch ladder lines enhance recoveries from unusual attitudes. Automatic deletion of the velocity vector symbol at high angles-of-attack also enhances recovery. Recommendations for future head-up display symbologies are made. GRA

N88-28922# Crew Systems Consultants, Yellow Springs, Ohio.
IMPROVEMENT OF HEAD-UP DISPLAY STANDARDS. VOLUME 5: HEAD UP DISPLAY ILS (INSTRUMENT LANDING SYSTEM) ACCURACY FLIGHT TESTS Final Report, 1 Oct. 1984 - 15 Jun. 1987
Richard L. Newman and Randall E. Bailey Sep. 1987 45 p
(Contracts F33615-85-C-3602; F33615-83-C-3603)
(AD-A194602; TR-87-13; AFWAL-TR-87-3055-Vol-5) Avail: NTIS HC A03/MF A01 CSCL 01D

An in-flight investigation of the effect of head-up display symbol accuracy has been conducted using a variable stability T-33 aircraft. The results indicate that 100 to 200 ft lateral errors and 500 to 1500 ft longitudinal errors in locating a contact analog synthetic runway did not cause difficulties for the evaluation pilots. There was no apparent tendency for the subjects to follow HUD cues and ignore real world cues. GRA

N88-28923# Management Consulting and Research, Inc., Falls Church, Va.
AIRCRAFT AVIONICS AND MISSILE SYSTEM INSTALLATION COST STUDY. VOLUME 1: TECHNICAL REPORT AND APPENDICES A THROUGH E Final Report, Apr. 1987 - Feb. 1988
Kirsten M. Pehrsson and George R. Kreisel 12 Feb. 1988 233 p
(Contract N00600-84-D-4171)
(AD-A194605; MCR-TR-8711/12-1) Avail: NTIS HC A11/MF A01 CSCL 05C

This report documents a parametric cost model for aircraft avionics installations and modifications. Cost and technical data collected during a previous avionics installation cost study, as well as data collected from data sources identified during this effort were used to analyze costs of individual avionics black-box modifications or installations into aircraft. The report details the methodology used to construct the data base and to develop cost-estimating relationships (CERs). Details of CERs developed for non-recurring costs, recurring installation/modification kit costs, labor costs, and manhours are provided, as well as the supporting data used in the analyses. The report is only available to authorized U.S. Government personnel. GRA

N88-29365*# Arizona State Univ., Tempe. Dept. of Computer Science.
AVIONIC EXPERT SYSTEMS
Forouzan Golshani *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 123-129 Sponsored in part by Sperry Research Trust Foundation (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 01D

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-28924# Purdue Univ., West Lafayette, Ind. Gas Turbine Combustion Lab.
SOOT AND RADIATION IN A GAS TURBINE COMBUSTOR Final Technical Report, 30 Sep. 1983 - 29 Sep. 1986
A. H. Lefebvre, P. E. Sojka, and W. G. Cummings, III 15 Jul. 1987 135 p
(Grant AF-AFOSR-0374-83)
(AD-A191991; AFOSR-88-0097TR) Avail: NT'S HC A07/MF A01 CSCL 21B

The effects of pressure, inlet air temperature, and fuel type on the soot threshold or critical equivalence ratio, are presented. Higher pressures yield lower soot thresholds, while no dependence on fuel type, as described by either the fuel hydrogen-to-carbon ratio, fuel molecular weight, number of carbon atoms, or number of carbon-carbon bonds, are observed. Variations in inlet air temperature have a complex effect; however, the results clearly show that the experimentally measured flame temperature is central to a description of the incipient soot formation process. The critical equivalence ratio dependence on pressure and temperature is shown to agree with a two-step semi-global model for soot precursor evolution for pressures from 0.1 to 0.8 MPa, and measured flame temperatures between 1600 and 2400 K. The effects of equivalence ratio, pressure, and fuel chemistry on total non-luminous flame radiation were also studied. Radiant intensity was highest for an equivalence ratio of unity and increased linearly with pressure of 0.4 to 0.8 MPa. GRA

N88-28925# Naval Air Development Center, Warminster, Pa. Air Vehicle and Crew Systems Technology Directorate.
AGARD (ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT) ENGINE DISC MATERIAL COOPERATIVE TEST (SUPPLEMENTARY PROGRAM)
Eun U. Lee 12 Aug. 1987 47 p
(AD-A193678; NADC-87169-60) Avail: NTIS HC A03/MF A01 CSCL 11F

From a gas turbine engine compressor spool of Ti-17 alloy, cylindrical unnotched specimens and flat double edge notched specimens were machined and fatigue-tested. The flat double edge notched specimens were also subjected to electrical potential drop measurements. The microstructure and fracture surface morphology of the representative specimens were examined. The variation of fatigue life, N, with applied stress range, delta sigma, was described by an equation of the form log N = a + b (delta sigma). The variation of normalized crack voltage, (V/V sub o)/(V sub R/V sub Ro), with normalized crack length, (a/w), was given by an equation of the form (V/V sub o)/(V sub R/V sub Ro) = A + A sub 1 (a/w) + A sub 2 (a/w)sq + A sub 3 (a/w) cu. GRA

N88-28926# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AGARD ENGINE DISC COOPERATIVE TEST PROGRAMME
A. J. A. Mom and M. D. Raizenne (National Aeronautical Establishment, Ottawa, Ontario) Aug. 1988 87 p
(AGARD-R-766; ISBN-92-835-0475-5) Copyright Avail: NTIS HC A05/MF A01

The initial results of an AGARD test program on fatigue behavior of engine disc materials are described. The first phase of the program, the Core Program, was aimed at test procedure and specimen standardization and calibration of the various laboratories. A detailed working document is included which describes the testing fundamentals and procedures and includes the analysis procedures used for handling the test data. Fatigue crack initiation and propagation testing was performed on Ti-6Al-4V material under room temperature and constant amplitude loading conditions using four different specimen designs. All results were statistically analyzed for possible significant differences in material behavior due to disc processing variables, specimen location in the disc or testing laboratory. Author

N88-28927*# Hamilton Standard, Windsor Locks, Conn.
EXPERIMENTAL AND ANALYTICAL EVALUATION OF THE EFFECTS OF SIMULATED ENGINE INLETS ON THE BLADE VIBRATORY STRESSES OF THE SR-3 MODEL PROP-FAN Final Report
Prem N. Bansal Sep. 1985 118 p
(Contract NAS3-24222)
(NASA-CR-174959; NAS 1.26:174959) Avail: NTIS HC A06/MF A01 CSCL 21E

A cooperative wind tunnel test program, referred to as GUN-3, had been conducted previously to assess the effect of inlet configuration and location on the inlet face pressure recovery and inlet drag in the presence of a high-speed advanced turboprop. These tests were conducted with the inlets located just downstream of the SR-3 model Prop-Fan, a moderately swept, eight-bladed 62.2 cm (24.5 inch) diameter advanced, high-speed turboprop model fabricated from titanium. During these tests, two blades of the SR-3 model Prop-Fan were strain gaged to measure the vibratory blade stresses occurring during the inlet aerodynamic test program. The purpose of the effort reported herein was to reduce and analyze the test results related to the vibratory strain gage measurements obtained. Three inlet configurations had been tested. These were: (1) single scoop, (2) twin scoop, and (3) annular. Each of the three inlets was tested at a position just behind the rotor. The single scoop inlet was also tested at a position further aft. Tests were also done without an inlet. These results emphasize the importance of avoiding critical speeds in the continuous operating range. B.W.

N88-28928*# Hamilton Standard, Windsor Locks, Conn.
SR-7A AEROELASTIC MODEL DESIGN REPORT
D. Nagle, S. Auyeung, and J. Turnberg Washington, D.C. Oct. 1986 118 p
(Contract NAS3-23051)
(NASA-CR-174791; NAS 1.26:174791; HSER-9251) Avail: NTIS HC A06/MF A01 CSCL 21E

A scale model was designed to simulate the aeroelastic characteristics and performance of the 2.74 meter (9 ft.) diameter SR-7L blade. The procedures used in this model blade design are discussed. Included in this synopsis is background information concerning scaling parameters and an explanation of manufacturing limitations. A description of the final composite model blade, made of titanium, fiberglass, and graphite, is provided. Analytical methods for determining the blade stresses, natural frequencies and mode shapes, and stability are discussed at length. Author

N88-28929*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
E3 10C COMPRESSOR TEST ANALYSIS OF HIGH-SPEED POST-STALL DATA
S. D. Dvorak, W. M. Hosny, and W. G. Steenken Oct. 1986 109 p
(Contract NAS3-24211)
(NASA-CR-179521; NAS 1.26:179521; R86AEB564) Avail: NTIS HC A06/MF A01 CSCL 21E

In-stall characteristics from high-speed post-stall transients are

determined. The transient, surge-cycle nature of high-speed post-stall operation precludes the possibility of obtaining in-stall characteristics in a steady-state manner, as is possible during low-speed post-stall operation, which is characterized by quasi-steady rotating-stall behavior. Maximum likelihood parameter estimation techniques were used to obtain the quasi-steady high-speed characteristics from transient data. The necessary data was first obtained from a specially instrumented compressor that was tested well beyond its limits of normal operation. The unsteady, post-stall data thus obtained was then digitized and processed through a simplified analytical model to construct the input-output relationship necessary for estimation. In-stall characteristics were determined using this estimation procedure at two different high-speed conditions, 90 and 98.5 percent corrected speed. The estimated characteristics were found to be robust in the presence of measurement noise and unmodelled system dynamics, but the compressor response-time constants, also estimated, were more sensitive to these same disturbances. The experimentally determined low-speed in-stall characteristics and the estimated high-speed in-stall characteristics were then incorporated into a one-dimensional compressor simulation model developed as a parallel effort to the compressor testing and data reduction effort, which yielded predictable results. Author

N88-28930*# United Technologies Corp., East Hartford, Conn.
THE EFFECTS OF INLET TURBULENCE AND ROTOR/STATOR INTERACTIONS ON THE AERODYNAMICS AND HEAT TRANSFER OF A LARGE-SCALE ROTATING TURBINE MODEL. VOLUME 3: HEAT TRANSFER DATA TABULATION 65 PERCENT AXIAL SPACING Final Report
R. P. Dring, M. F. Blair, and H. D. Joslyn Washington, D.C. May 1988 235 p
(Contract NAS3-23717)
(NASA-CR-179468; NAS 1.26:179468; UTRC-R86-956480-Vol-3) Avail: NTIS HC A11/MF A01 CSCL 21E

This is Volume 3 - Heat Transfer Data Tabulation (65% Axial Spacing) of a combined experimental and analytical program which was conducted to examine the effects of inlet turbulence on airfoil heat transfer. The experimental portion of the study was conducted in a large-scale (approximately 5X engine), ambient temperature, rotating turbine model configured in both single stage and stage-and-a-half arrangements. Heat transfer measurements were obtained using low-conductivity airfoils with miniature thermocouples welded to a thin, electrically heated surface skin. Heat transfer data were acquired for various combinations of low or high inlet turbulence intensity, flow coefficient, first-stator/rotor axial spacing, Reynolds number and relative circumferential position of the first and second stators. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-28931# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TIME PERIODIC CONTROL OF A MULTI-BLADE HELICOPTER Ph.D. Thesis
Stephen G. Webb May 1988 218 p
(AD-A194435; AFIT/DS/AA/88-2) Avail: NTIS HC A10/MF A01 CSCL 01C

The flap-lag equations of motion of an isolated rotor blade and those for a rigid helicopter containing four blades free to flap and lag are derived. Control techniques are developed which stabilize both systems for a variety of flight conditions. Floquet theory is used to investigate the stability of a rotor blade's flap-lag motion. A modal control technique, based on Floquet theory, is used to eliminate the blade's instabilities using collective and cyclic pitch control mechanisms. The technique shifts the unstable roots to desired locations while leaving the other roots unaltered. The control, developed for a single design point, is shown to significantly reduce or eliminate regions of flap-lag instabilities for a variety of off-design conditions. Both scalar and vector control are successfully used to stabilize the blade's motion. Coupling the flap-lag equations of motion of four rotor blades to a rigid airframe alters the flap lag, and airframes roots. The airframe roots are stabilized using a combination of the body's pitch attitude and pitch rate feedback to the main rotor's longitudinal cyclic pitch. The modal control technique is used to eliminate multiple blade instabilities by first controlling a pair of unstable roots at a specific design point. The resulting closed loop system is a new linear system with periodic coefficients. Another modal controller is designed for this new system to shift a second pair of unstable roots to desired locations. GRA

N88-28932# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.
VARIABLE WING CAMBER CONTROL SYSTEMS FOR THE FUTURE AIRBUS PROGRAM Final Report, Jun. 1987
Juergen Renken Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Feb. 1988 132 p In GERMAN; ENGLISH summary
(Contract BMFT-LFL-83618)
(MBB-UT-104/88; ETN-88-92965) Avail: NTIS HC A07/MF A01

The physics background of camber variation is overviewed. The principles of the mechanical realization of chordwise and spanwise camber variation, including the effects of elastic deformation, the actuation and control concepts, camber laws and performance maximization including the effects on the operational flight and the implementation of the variable camber function in an A-320 aircraft are described. The potential fuel saving benefits of camber variation and the technical investment are related to the other high cost, high risk technological efforts aiming at further fuel saving performed in the entire aircraft scenario. It is concluded that with the presented camber variation a technology is available which offers a considerable fuel saving potential at low cost, low risk, and with a negligible weight increase. ESA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-28933*# Applied Cryogenics and Materials Consultants, Inc., Hampton, Va.
TECHNOLOGY FOR PRESSURE-INSTRUMENTED THIN AIRFOIL MODELS Final Report
David A. Wigley Washington Sep. 1988 42 p
(Contract NAS1-18066)
(NASA-CR-4173; NAS 1.26:4173) Avail: NTIS HC A03/MF A01 CSCL 14B

A novel method of airfoil model construction was developed. This Laminated Sheet technique uses 0.8 mm thick sheets of A286 containing a network of pre-formed channels which are vacuum brazed together to form the airfoil. A 6.25 percent model of the X29A canard, which has a 5 percent thick section, was built using this technique. The model contained a total of 96 pressure orifices, 56 in three chordwise rows on the upper surface and 37 in three similar rows on the lower surface. It was tested in the NASA Langley 0.3 m Transonic Cryogenic Tunnel. Unique aerodynamic data was obtained over the full range of temperature and pressure. Part of the data was at transonic Mach numbers and flight Reynolds number. A larger two dimensional model of the NACA 64a-105 airfoil section was also fabricated. Scale up

presented some problems, but a testable airfoil was fabricated.
Author

N88-28934# Massachusetts Inst. of Tech., Lexington.
AIRPORT SURFACE TRAFFIC AUTOMATION STUDY
Walter M. Hollister 9 May 1988 80 p
(Contract F19628-85-C-0002)
(AD-A194553; ATC-156; DOT/FAA/PS-87/1) Avail: NTIS HC A05/MF A01 CSCL 17G

This report documents a study of requirements for an Airport Surface Traffic Automation (ASTA) system. The objective was to determine the necessary functions, establish the cost and benefits, and outline a modular system design. The highest priority function identified was an improved surface surveillance and communication system. The greatest potential for safety benefits is provided by automatic conflict alert and collision warning for pilots and controllers to prevent runway incursion accidents. Strategic and tactical planning assistance to maximize runway utilization can improve controller productivity while keeping them responsible for final decisions. The report contains a modular design for ASTA and includes specifications for a man-in-the loop simulation of the system. GRA

N88-28935# Naval Postgraduate School, Monterey, Calif.
FLOW VISUALIZATION ON A SMALL SCALE M.S. Thesis
Roy L. Hixson, III Mar. 1988 42 p
(AD-A194728) Avail: NTIS HC A03/MF A01 CSCL 14B

A quarter scale model of the planned renovated form of an existing flow visualization tunnel was designed and constructed to test the quality of flow and for small scale research and flow visualization demonstrations. Three flow visualization techniques were developed, including fog injection, helium bubbles, and smoke wire. In addition to velocity calibration and test section mapping of the tunnel, the latter two of these methods were used for visualizing flows around three different shaped bodies as demonstration that the tunnel's design objectives were realized. Both techniques produced excellent photographic results of flows around a block of rectangular cross section, a circular cylinder and an airfoil. GRA

N88-28936# Naval Postgraduate School, Monterey, Calif.
HOT-WIRE MEASUREMENTS OF COMPRESSOR BLADE WAKES IN A CASCADE WIND TUNNEL M.S. Thesis
Adem Baydar Mar. 1988 58 p
(AD-A194737) Avail: NTIS HC A04/MF A01 CSCL 14B

A hot-wire system, with software designed for calibrating and taking data with single, double and triple hot-wire sensors separately, or three probes at once, was verified and used to make wake measurements downstream of a compressor stator blade in a cascade wind tunnel. Using a single hot-wire probe, velocity and turbulence data were obtained in the wake of the controlled-diffusion blade in order to verify laser Doppler velocimeter (LDV) data taken in earlier studies. The tests were conducted at three inlet angles from near design incidence towards the expected stall condition at a Mach number of 0.25 and Reynolds number of about 700,000. Wake profiles were obtained from 0.08 to 0.2 chord lengths downstream of the blade. Good agreement was found with LDV measurements. Measurements at the highest incidence angle showed that the wake constituted one third of the flow and yet no separation occurred before the trailing edge on the suction side of the blade. GRA

N88-28937# Los Alamos National Lab., N. Mex.
PROOF-OF-PRINCIPLE HIGH SPEED ELECTRONIC IMAGING SYSTEM, PHASE 2 Final Report, Oct. 1984 - Oct. 1987
David M. Holt Mar. 1988 73 p
(Contract MIPR-FY7621-87-90042; AF Proj. 2567)
(AD-A193798; AFATL-TR-88-14) Avail: NTIS HC A04/MF A01 CSCL 14D

The feasibility of using electronic imaging technology for aeroballistics research has been proven with the installation and testing of the High Speed Electronic Imaging System at the Eglin Aeroballistics Research Facility. Test results obtained using the system have produced high resolution data with the accuracy and precision required in the Aeroballistics Research Facility. GRA

N88-28938*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HIGH TEMPERATURE ELECTRIC ARC FURNACE Patent Application
Richard M. Poorman, inventor (to NASA) and Deborah D. Schmidt, inventor (to NASA) 13 Jun. 1988 12 p
(NASA-Case-MFS-28281-1; NAS 1.71:MFS-28281-1; US-Patent-Appl-SN-205898) Avail: NTIS HC A03/MF A01 CSCL 14B

An apparatus and process for improving the microstructure of electrically conducting materials is disclosed by the present invention. A revolving heat source applies heat to the surface of the material evenly and quickly. One or more heat sinks quickly cool the material. In the preferred embodiment, the cooling may be done in such a way as to promote as high a degree of directional grain growth as desired or completely nondirectional grain growth.
NASA

N88-28939* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ARCJET POWER SUPPLY AND START CIRCUIT Patent
Robert P. Gruber, inventor (to NASA) 30 Aug. 1988 5 p
Filed 10 Jun. 1987 Supersedes N87-25335 (25 - 19, p 2573)
(NASA-Case-LEW-14374-1; US-Patent-4,766,724; US-Patent-Appl-SN-060200; US-Patent-Class-60-203.1; US-Patent-Class-219-383; US-Patent-Class-363-97) Avail: US Patent and Trademark Office CSCL 14B

A dc power supply for spacecraft arcjet thrusters has an integral automatic starting circuit and an output averaging inductor. The output averaging inductor, in series with the load, provides instantaneous current control, and ignition pulse and an isolated signal proportional to the arc voltage. A pulse width modulated converter, close loop configured, is also incorporated to give fast response output current control.
Official Gazette of the U.S. Patent and Trademark Office

N88-28858# Potter (J. Leith), Nashville, Tenn.
MISSILES, FUSELAGE AND SIMILAR BODIES
J. Leith Potter *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 5-20 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28859*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HIGH-ASPECT-RATIO WINGS
John B. Peterson, Jr. *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 21-29 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01 CSCL 14B

N88-28861# British Aerospace Public Ltd. Co., Weybridge (England). Aircraft Group.
COMPLEX CONFIGURATIONS
A. G. T. Cross *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 50-67 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28862# National Aerospace Lab., Amsterdam (Netherlands).
REYNOLDS NUMBER EFFECTS AND THE WIND TUNNEL ENVIRONMENT
A. Elsenaar *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 68-79 Previously announced as N87-18546 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28863# Naples Univ. (Italy). Experimental Gasdynamics
TECHNIQUES FOR BOUNDARY LAYER TRIPPING AND CONTROL
G. P. Russo *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 80-90 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28864# Aircraft Research Association Ltd., Bedford (England).
EXPERIMENTAL TOOLS: THE TUNNEL AND THE MODEL
A. B. Haines and A. Elsenaar *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 111-114 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28865# National Research Council of Canada, Ottawa (Ontario).
COMPUTATIONAL TOOLS FOR SIMULATION METHODOLOGIES
Y. Y. Chan *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 115-131 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28866# National Aerospace Lab., Amsterdam (Netherlands).
EMPIRICAL TOOLS FOR SIMULATION METHODOLOGIES
A. Elsenaar and A. B. Haines (Aircraft Research Association Ltd., Bedford, England) *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 132-138 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

No abstracts in this category.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-28940# Naval Postgraduate School, Monterey, Calif.
INTERACTIVE, NETWORKED MOVING PLATFORM SIMULATORS M.S. Thesis
Michael R. Oliver, David J. Stahl, Jr., Robert B. McGhee, and Michael J. Zyda Feb. 1988 133 p
(Contracts MIPR-ATEC-48-47; MIPR-AT-E9-49-87)
(AD-A192374; NPS52-88-002) Avail: NTIS HC A07/MF A01 CSCL 16B

Previous research has produced a real time FOG-M missile flight simulation using defense Mapping Agency digital terrain elevation data and a Silicon Graphics, Inc. IRIS 3120 graphics workstation. This study is a continuation of that project with the goals of providing more realistic targets and allowing viewing the terrain from inside several different types of vehicles. In addition, the use of Ethernet network communications between two workstations taking part in the simulation is used to create a missile/target gaming environment. GRA

N88-28941# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LRS-2: A SPECIALIZED KNOWLEDGE SYSTEM FOR LAUNCH RESOURCE SCHEDULING M.S. Thesis
James E. Crawford, Jr. Dec. 1987 116 p
(AD-A194625; AFIT/GE/ENG/87D-11) Avail: NTIS HC A06/MF A01 CSCL 05A

The Level 5 expert system software is used to develop a specialized knowledge system called the Launch Resource Scheduling system (LRS-2). LRS-2 will be used as a decision aid by USSPACECOM to determine if there is sufficient launch capability to meet future satellite requirements and to quickly assess the impact of contingencies such as launch or on-orbit failures. LRS-2 uses multiple knowledge bases to match satellite launch requirements to available launch vehicles, launch pads, and upper stages. Specialized knowledge about satellite requirements and launch resources are stored in dBase III files. Level 5 knowledge base rules match specific fields of the satellite record against fields in the resource records to schedule the earliest launch resources that meet the satellite requirement. If two different types of launch vehicles are capable of launching a satellite, LRS-2 selects the launch vehicle that meets the requirement earliest. If the satellite constellation allows multiple satellites on a single launch vehicle, specialized knowledge bases are executed to manifest the additional satellites. During manifesting, the constraints of satellite and resources availability, site processing time, shuttle mission duration, and satellite on-orbit checkout time are used to insure the selected launch date is accurate. GRA

N88-28942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS RESEARCH CENTER SPACE STATION ELECTRIC POWER SYSTEM TEST FACILITIES
Arthur G. Birchenough and Donald F. Martin 28 Apr. 1988 30 p
(NASA-TM-100924; E-3904; NAS 1.15:100924) Avail: NTIS HC A03/MF A01 CSCL 14B

NASA Lewis Research Center facilities were developed to support testing of the Space Station Electric Power System. The capabilities and plans for these facilities are described. The three facilities which are required in the Phase C/D testing, the Power Systems Facility, the Space Power Facility, and the EPS Simulation Lab, are described in detail. The responsibilities of NASA Lewis and outside groups in conducting tests are also discussed.
Author

N88-29379*# Alabama Univ., Huntsville.
OMV DOCKING SIMULATOR
W. Teoh and J. Hawkins (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 257-276 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 14B

N88-29411*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EXPERT SYSTEM FOR A DISTRIBUTED REAL-TIME TRAINER
Steven C. Purinton and Caroline K. Wang *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 545-554 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-28943# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France). Advanced Studies Dept.
ARIANE 5, HERMES AND EUROPEAN VEHICLES FOR SPACE STATION SERVICING
Patrick Eymar and Jean M. Roubertie 1987 38 p Presented at the French Aerospace 1987 Conference, Groupement des Industries Francaises Aeronautiques et Spatiales, Washington, D.C., 20-23 Jan. 1987
(SNIAS-881-422-102; ETN-88-92846) Avail: NTIS HC A03/MF A01

European space goals for the next decade; space infrastructure and associated logistics and servicing; Ariane 5; Ariane 5 transfer stages and logistic modules; the HERMES spaceplane; reentry vehicles; and intravehicular and extravehicular activities are discussed. ESA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N88-28944*# Eagle Engineering, Inc., Houston, Tex.
SPACE TRANSPORTATION NODES ASSUMPTIONS AND REQUIREMENTS: LUNAR BASE SYSTEMS STUDY TASK 2.1
Taher Ali Kahn, Charles H. Simonds, and William R. Stump 18 Apr. 1988 86 p
(Contracts NAS9-17878; TO-87-57)
(NASA-CR-172052; NAS 1.26:172052; EEI-87-174) Avail: NTIS HC A05/MF A01 CSCL 22B

The Space Transportation Nodes Assumptions and Requirements task was performed as part of the Advanced Space Transportation Support Contract, a NASA Johnson Space Center (JSC) study intended to provide planning for a Lunar Base near the year 2000. The original task statement has been revised to satisfy the following queries: (1) What vehicles are to be processed at the transportation node; (2) What is the flow of activities involved in a vehicle passing through the node; and (3) What node support resources are necessary to support a lunar scenario traffic model composed of a mix of vehicles in an active flight schedule. The Lunar Base Systems Study is concentrating on the initial years of the Phase 2 Lunar Base Scenario. The study will develop the first five years of that phase in order to define the transportation and surface systems (including mass, volumes, power requirements, and designs). F.M.R.

N88-28945# Spectral Sciences, Inc., Burlington, Mass.
PROGRESS ON A MONTE CARLO SHUTTLE CONTAMINATION MODEL Scientific Report No. 2, Oct. 1986 - Sep. 1987
James B. Elgin 1 Feb. 1988 34 p
(Contract F19628-85-C-0195)
(AD-A193694; SSI-TR-134; AFGL-TR-88-0028) Avail: NTIS HC A03/MF A01 CSCL 22E

This is the second yearly scientific report on a three year effort to develop a Monte Carlo model of contamination for the space shuttle orbiter. Contamination of instruments on the space shuttle orbiter is an issue of major concern. The shuttle gives off matter through surface outgassing, via various thrusters and from flash evaporators. At altitudes where the atmospheric mean free path is comparable to or less than shuttle dimensions, the deposition back onto shuttle-borne instruments will be largely determined by the multiple collision environment surrounding the shuttle. Even at higher altitudes, this may be the dominant source of contaminants for some portions of the shuttle. In addition to physical contamination of shuttle surfaces, radiation contamination is also a potential problem as gases surrounding the shuttle collide at high speed with atmospheric molecules. These energetic collisions can lead to vibrational excitation and subsequent radiative decay. A similar issue of some concern is the presence of ions in the vicinity of the shuttle which can (possibly) be produced via the critical ionization effect (the SOCRATES code), acronym for Shuttle Orbiter Contamination Representation Accounting for Transiently Emitted Species. GRA

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N88-28946*# National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD FOR VETERBI DECODING OF LARGE CONSTRAINT LENGTH CONVOLUTIONAL CODES Patent Application
In-Shek Hsu, inventor (to NASA), Trieu-Kie Truong, inventor (to NASA), Irving S. Reed, inventor (to NASA), and Sun Jing, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 20 May 1988 35 p
(NASA-Case-NPO-17310-1-CU; NAS 1.71:NPO-17310-1-CU; US-Patent-Appl-SN-200874) Avail: NTIS HC A03/MF A01 CSCL 09F

A new method of Viterbi decoding of convolutional codes lends itself to a pipline VLSI architecture using a single sequential processor to compute the path metrics in the Viterbi trellis. An array method is used to store the path information for NK intervals where N is a number, and K is constraint length. The selected path at the end of each NK interval is then selected from the last entry in the array. A trace-back method is used for returning to the beginning of the selected path back, i.e., to the first time unit of the interval NK to read out the stored branch metrics of the selected path which correspond to the message bits. The decoding decision made in this way is no longer maximum likelihood, but can be almost as good, provided that constraint length K in not too small. The advantage is that for a long message, it is not necessary to provide a large memory to store the trellis derived information until the end of the message to select the path that is to be decoded; the selection is made at the end of every NK time unit, thus decoding a long message in successive blocks. NASA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-28947*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
NUCLEAR AND IONIC CHARGE DISTRIBUTION EXPERIMENT ON ISEE-1 AND ISEE-3 Final Scientific Report, 1 Dec. 1984 - 29 Nov. 1985
G. Gloeckler, F. M. Ipavich, and A. B. Galvin 20 May 1987 39 p

(Contract NAS5-28704)
(NASA-CR-180776; NAS 1.26:180776) Avail: NTIS HC A03/MF A01 CSCL 22B

The experimental work carried out under this contract is a continuation of that originally performed under Contracts NAS5-20062 and NAS5-26739. The data analyzed are from the Max-Planck Institut/Univ. of Maryland experiment on ISEE-1 and ISEE-3. Each spacecraft experiment consists of a nearly identical set of three sensors (designated the ULECA, ULEWAT, and ULEZEQ sensors) designed to measure the energy spectra and composition of suprathermal and energetic ions over a broad energy range (less than 3 keV/e to more than 20 MeV/nucleon). Since the launch of ISEE's 2 and 3, the MPI/Univ. of Maryland experiments have generally performed as expected except for a partial failure of the ULEWAT sensor on ISEE-1 in August 1978. A number of scientific studies have either been completed, initiated or are at various stages of completion. A brief summary of Primary Results is given, followed by a more detailed summary of the major accomplishments at the Univ. of Maryland. Author

N88-28948# Los Alamos National Lab., N. Mex.
DEFENSIVE PLATFORM SIZE AND SURVIVABILITY
Gregory H. Canavan Jun. 1988 40 p
(Contract W-7405-eng-36)
(DE88-011634; LA-11244-MS) Avail: NTIS HC A03/MF A01

This report discusses the survivability of space platforms, concentrating on space based kinetic energy interceptors. It evaluates the efficacy of hardening, maneuver, self-defense, and deception in extending the survivability of platforms of varying sizes to expected threats, concluding that they should be adequate in the near and mid terms. DOE

N88-28949*# TRW Defense and Space Systems Group, Houston, Tex.
STUDY OF PLASMA MOTOR GENERATOR (PMG) TETHER SYSTEM FOR ORBIT REBOOST Final Report
Jun. 1988 103 p
(Contract NAS9-17751)
(NASA-CR-172074; NAS 1.26:172074) Avail: NTIS HC A06/MF A01 CSCL 22B

A progress report is given on a system study by TRW begun in January 1987 of a 2 kW Plasma Motor Generator Tether to be used for orbit reboost. Following the completion of the initial phase in September 1987, additional tasks were agreed on and work on them begun in March 1988. These tasks fell into three categories: tests on the prototype tether fabricated during the first phase, simulations of the spacecraft and tether system after deployment using GTOSS, and a brief investigation of the impact and feasibility of increasing the system to 20 kW and hosting it on the Orbital Maneuvering Vehicle. The subcontractor, Energy Sciences Laboratory, was assigned the responsibility of performing the simulations and some mechanical tests on the prototype tether to supplement those done at TRW. A summary of the significant findings and issues from each task follows. Recommendations for future work constitutes the third section. A copy of the final briefing is in Appendix A, plus additional reports for each task and additional analysis. Author

N88-28950*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ANALYTICAL INVESTIGATION OF THE DYNAMICS OF TETHERED CONSTELLATIONS IN EARTH ORBIT Quarterly Report No. 13, 1 Apr. - 30 Jun. 1988
Enrico C. Lorenzini, Gordon E. Gullahorn, and Robert D. Estes Jul. 1988 124 p
(Contract NAS8-36606)
(NASA-CR-179371; NAS 1.26:179371) Avail: NTIS HC A06/MF A01 CSCL 22B

This Quarterly Report on Tethering in Earth Orbit deals with three topics: (1) Investigation of the propagation of longitudinal and transverse waves along the upper tether. Specifically, the upper tether is modeled as three massive platforms connected by two perfectly elastic continua (tether segments). The tether attachment point to the station is assumed to vibrate both longitudinally and transversely at a given frequency. Longitudinal and transverse waves propagate along the tethers affecting the acceleration levels at the elevator and at the upper platform. The displacement and acceleration frequency-response functions at the elevator and at the upper platform are computed for both longitudinal and transverse waves. An analysis to optimize the damping time of the longitudinal dampers is also carried out in order to select optimal parameters. The analytical evaluation of the performance of tuned vs. detuned longitudinal dampers is also part of this analysis. (2) The use of the Shuttle primary Reaction Control System (RCS) thrusters for blowing away a recoiling broken tether is discussed. A microcomputer system was set up to support this operation. (3) Most of the effort in the tether plasma physics study was devoted to software development. A particle simulation code has been integrated into the Macintosh II computer system and will be utilized for studying the physics of hollow cathodes. Author

N88-28951# Air Command and Staff Coll., Maxwell AFB, Ala.
THE SOVIET MIR SPACE STATION
Thomas E. Snook Apr. 1988 35 p
(AD-A194040; ACSC-88-2445) Avail: NTIS HC A03/MF A01 CSCL 22B

The purpose of this paper was to determine if the Soviet MIR space station represents a significant advance when compared to the Soviets' preceding Salyut 7 space station. A description and comparison of the physical features of Salyut 7 and MIR are presented. A discussion and analysis of the scientific, commercial, military and political uses or missions of the Salyut 7 and MIR space stations are included. The MIR space station is determined to be a significant advance relative to the Salyut 7 space station. GRA

N88-28952# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Raumflugdynamik.
ON THE COLLISION HAZARD OF COLOCATED GEOSTATIONARY SATELLITES
Alexander Haerting, Martin C. Eckstein, Alois Leibold, and Kanduru N. SrinivasaMurthy (Indian Space Research Organization, Bangalore.) Dec. 1987 66 p
(DFVLR-FB-88-02; ISSN-0171-1342; ETN-88-92920) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 23.50 Deutsche marks

The collision hazard of 2 colocated geostationary satellites within a + or - 0.1 deg tolerance window is investigated by computer simulation of the controlled motion including the error effects of modeling, orbit determination, and maneuver execution. Modifications of the basic stationkeeping strategy are introduced in order to separate the two satellites, even in the presence of errors. The latter are simulated by a multivariate normal random generator and superimposed on the controlled motion. Roughly 500 yr of station keeping are simulated for each separation policy. The statistical evaluation indicates that identical control strategies for both satellites leads to a high collision risk, and only some of the tested separation policies reduce the hazard to an acceptable level at the cost of a small increase in fuel consumption. The colocation of more than two satellites needs further investigation. ESA

N88-28953# Technische Univ., Munich (West Germany). Fakultaet fuer Mathematik und Informatik.
TIME MINIMAL COMPUTATION OF FEEDBACK CONTROL SCHEMES FOR OPTIMAL GUIDANCE PROBLEMS USED IN SPACE FLIGHT Ph.D. Thesis [ZEITMINIMALE BERECHNUNG VON RUECKKOPPLUNGSSTEUERUNGEN FUER OPTIMALE LENKUNGSPROBLEME MIT ANWENDUNG IN DER RAUMFAHRT]
Bernd Kugelmann 1987 92 p In GERMAN
(ETN-88-92989) Avail: NTIS HC A05/MF A01

For linearization of complex nonlinear conditions of fuzzy problems, an algorithm suitable for the treatment of trajectory

correction problems is developed. Effectiveness of this method is based on repeated corrections and damping of defects. Correction is performed for the present state of the system and cannot predict future trajectory evolution. The procedure is tested on a space flight example by using the path correction algorithm for optimal reentry maneuvering of a reusable space shuttle. ESA

N88-28954# Societe Nationale Industrielle Aerospatiale, Cannes (France).
STUDY OF A SAFE ATTITUDE FOR THE INFRARED SPACE OBSERVATORY (ISO) DURING PERIGEE PASS
Jacques Busseuil and Herve Renault 1988 24 p Presented at the 11th Annual American Astromical Society's Guidance and Control Conference, Keystone, Colo., 30 Jan. - 3 Feb. 1988
(SNIAS-881-440-113; ETN-88-92877) Avail: NTIS HC A03/MF A01

The need to protect the Infrared Space Observatory telescope and cryogenic cooling system from sun and earth radiation during operation is explained, and the particular difficulties for attitude control during perigee pass are discussed. Safe perigee pass in nominal and degraded modes, i.e., assessment of the safe pointing domain as a function of launch date and daily launch windows; possible trajectories (slews) during perigee pass, taking into account actuator performances; and a strategy to avoid (or minimize) constraints violation in degraded mode, so called survival mode where the satellite is assumed to have lost ground contact and orbit data are considered. It is concluded that attitude and orbit control remains critical in certain orbital cases, but can be performed with the baseline sensors and actuators. ESA

N88-28955# MATRA Espace, Toulouse (France).
STUDY OF STANDARD GENERIC APPROACH FOR SPACECRAFT (S/C) AUTONOMY AND AUTOMATION (PHASE 3). BOOK A: AUTONOMY CONCEPT DESCRIPTION Final Report
Paris, France ESA Nov. 1987 344 p Prepared in cooperation with MBB GmbH, Ottobrunn, Fed. Republic of Germany and Dornier-Werke GmbH, Friedrichshafen, Fed. Republic of Germany
(Contract ESTEC-6358/85-NL-PP(SC))
(ESA-CR(P)-2555-Vol-1; ETN-88-92914) Copyright Avail: NTIS HC A15/MF A01

A generic system design concept for unmanned autonomous spacecraft, especially the definition of an on-board management system, is outlined. Autonomy is defined as the capability of the spacecraft to autonomously manage its nominal operations and that of the payload according to the goals and options prescribed by a resident short term operational plan without the need for ad-hoc ground interventions. It implies that if predictable failures occur, they are automatically sorted out in such a way that nominal operations can be continued in full or part without resorting to a noneffective safety mode. Routine and crisis modes are described. Division of tasks between on-board and ground is summarized, and on-board organization is shown. Subsystems are detailed. A development approach is proposed. ESA

N88-28956# MATRA Espace, Toulouse (France).
STUDY OF STANDARD GENERIC APPROACH FOR SPACECRAFT (S/C) AUTONOMY AND AUTOMATION (PHASE 3). BOOK B: AUTONOMY CONCEPT APPLICATION EXAMPLE Final Report
Paris, France ESA Nov. 1987 324 p Prepared in cooperation with MBB GmbH, Ottobrunn, Fed. Republic of Germany and Dornier-Werke GmbH, Froedrichshafen, Fed. Republic of Germany
(Contract ESTEC-6358/85-NL-PP(SC))
(ESA-CR(P)-2555-Vol-2; ETN-88-92915) Copyright Avail: NTIS HC A14/MF A01

A generic system design concept for unmanned spacecraft is applied to EURECA. Allocation of autonomy requirements; system level applications; and subsystems are described. Functional and operational interfaces are discussed. Spacecraft modes of operation and the functional partitioning between the spacecraft and ground control are treated. On-board architecture; functional autonomy and on-board organization, interfaces, and the utilization of a local area network to interconnect the on-board management nodes are outlined. ESA

N88-28957# MATRA Espace, Toulouse (France).
STUDY OF STANDARD GENERIC APPROACH FOR SPACECRAFT (S/C) AUTONOMY AND AUTOMATION (PHASE 3). BOOK C: AUTONOMY CONCEPT SUMMARY Final Report
Paris, France ESA Nov. 1987 106 p Prepared in cooperation with MBB GmbH, Ottobrunn, Fed. Republic of Germany and Dornier-Werke GmbH, Friedrichshafen, Fed. Republic of Germany
(Contract ESTEC-6358/85-NL-PP(SC))
(ESA-CR(P)-2555-Vol-3; ETN-88-92916) Copyright Avail: NTIS HC A06/MF A01

A generic system design concept for unmanned autonomous spacecraft, especially the definition of an on-board management system, is outlined. A procedure to identify autonomy requirements for a given mission is presented. On-board system architecture is described. Subsystems are detailed. A development approach is proposed. ESA

N88-28958* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
EXPANDABLE PALLET FOR SPACE STATION INTERFACE ATTACHMENTS Patent
Clarence J. Wesselski, inventor (to NASA) 23 Aug. 1988 11 p Filed 13 Nov. 1986 Supersedes N87-18597 (25 - 11, p 1446)
(NASA-Case-MSC-21117-1; US-Patent-4,765,114;
US-Patent-Appl-SN-929875; US-Patent-Class-52-646;
US-Patent-Class-52-648) Avail: US Patent and Trademark Office CSCL 22B

Described is a foldable expandable pallet for Space Station interface attachments with a basic square configuration. Each pallet consists of a series of struts joined together by node point fittings to make a rigid structure. The struts have hinge fittings which are spring loaded to permit collapse of the module for stowage transport to a Space Station in the payload bay of the Space Shuttle, and development on orbit. Dimensions of the pallet are selected to provide convenient, closely spaced attachment points between the node points of the relatively widely spaced trusses of a Space Station platform. A pallet is attached to a strut at four points: one close fitting hole, two oversize holes, and a slot to allow for thermal expansion/contraction and for manufacturing tolerances. Applications of the pallet include its use in rotary or angular joints; servicing of splints; with gridded plates; as instrument mounting bases; and as a roadbed for a Mobile Service Center (MSC). Official Gazette of the U.S. Patent and Trademark Office

N88-28959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ASSESSMENT OF THE EFFECTS OF SPACE DEBRIS AND METEOROIDS ENVIRONMENT ON THE SPACE STATION SOLAR ARRAY ASSEMBLY
Henry K. Nahra Sep. 1988 11 p Presented at the 20th Photovoltaic Specialists Conference, Las Vegas, Nev., 26-30 Sep. 1988; sponsored in part by IEEE
(NASA-TM-101315; E-4310; NAS 1.15:101315) Avail: NTIS HC A03/MF A01 CSCL 22B

The methodology used to assess the probability of no impact of space debris and meteoroids on a spacecraft structure is applied to the Space Station solar array assembly. Starting with the space debris and meteoroids flux models, the projected surface area of the solar cell string circuit of the solar array panel and the mast longeron, and the design lifetime, the possibility of no impact on the solar array mast and solar cell string circuits was determined as a function of particle size. The probability of no impact on the cell string circuits was used to derive the probability of no open circuit panel. The probability of meeting a certain power requirement at the end of the design lifetime was then calculated as a function of impacting particle size. Coupled with a penetration and damage models/correlations which relate the particle size to the penetration depth and damage, the results of this analysis can be used to

determine the probability of meeting the lower power requirement given a degree of redundancy, and the probability of no impact on the solar array mast. Author

N88-29352*# National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION AS A VITAL FOCUS FOR ADVANCING THE TECHNOLOGIES OF AUTOMATION AND ROBOTICS
Giulio Varsi (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Daniel H. Herman *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 1-6 (For primary document see N88-29351 23-61)
(IAF-86-62) Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29374*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
KNOWLEDGE-BASED FAULT DIAGNOSIS ON FUTURE SPACE VEHICLES
Robert L. Schroeder *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 209-213 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29377*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.
A PLAN FOR TIME-PHASED INCORPORATION OF AUTOMATION AND ROBOTICS ON THE US SPACE STATION
R. B. Purves, P. S. Lin, and E. M. Fisher, Jr. *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 237-245 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29378*# Boeing Computer Services Co., Seattle, Wash. Advanced Technology Center for Computer Sciences.
MOTION PLANNING FOR A FREE-FLYING ROBOT
Donald Leo Kaiser and Patrick J. Hawkins *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 247-255 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29381*# TRW, Inc., Redondo Beach, Calif.
SCARES: A SPACECRAFT CONTROL ANOMALY RESOLUTION EXPERT SYSTEM
Marc Hamilton *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 283-291 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29395*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
REASONING ABOUT FAULT DIAGNOSIS FOR THE SPACE STATION COMMON MODULE THERMAL CONTROL SYSTEM
G. Vachtsevanos, H. Hexmoor, and B. Purves (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 403-412 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29402*# Boeing Aerospace Co., Seattle, Wash.
A SPACE STATION ONBOARD SCHEDULING ASSISTANT
A. F. Brindle and B. H. Anderson *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 457-463 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

N88-29419*# LISP Machines, Inc., Los Angeles, Calif.
REAL-TIME SPACE SYSTEM CONTROL WITH EXPERT SYSTEMS
David Leinweber, Lowell Hawkinson, and John Perry (OAO Corp., Los Angeles, Calif.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 607-609 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-28960# Oak Ridge National Lab., Tenn.
TRANSIENT THERMAL ANALYSIS OF THREE FAST-CHARGING LATENT HEAT STORAGE CONFIGURATIONS FOR A SPACE-BASED POWER SYSTEM
T. K. Stovall and R. V. Arimilli 1988 8 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. 1988 Prepared in cooperation with Tennessee Univ., Knoxville
(Contract DE-AC05-84OR-21400)
(DE88-009714; CONF-880702-5) Avail: NTIS HC A02/MF A01

A space-based thermal storage application must accept large quantities of heat in a short period of time at an elevated temperature. A model of a lithium hydride phase change energy storage system was used to estimate reasonable physical dimensions for this application which included the use of a liquid metal heat transfer fluid. A finite difference computer code was developed and used to evaluate three methods of enhancing heat transfer in the PCM energy storage system. None of these three methods, inserting thin fins, reticulated nickel, or liquid lithium, significantly improved the system performance. The use of a 95 percent void fraction reticulated nickel insert was found to increase the storage capacity (total energy stored) of the system slightly with only a small decrease in the system energy density (energy storage/system mass). The addition of 10 percent liquid lithium was found to cause minor increases in both storage density and storage capacity with the added benefit of reducing the hydrogen pressure of the lithium hydride. DOE

N88-28961# Sverdrup Technology, Inc., Arnold Air Force Station, Tenn.
ANALYSIS OF EDGE DETECTION TECHNIQUES FOR RADIOGRAPHIC IMAGE MEASUREMENT Final Report, Jan. 1986 - Nov. 1987
A. L. Nasser Apr. 1988 38 p Prepared in cooperation with AEDC, Arnold AFS, Tenn.
(AD-A193650; AEDC-TR-87-39) Avail: NTIS HC A03/MF A01 CSCL 21H

Personnel at the Arnold Engineering Development Center (AEDC) routinely X-ray inspect solid rocket motors. From the visual inspection of these data, potentially dangerous situations have been avoided by preventing the test of damaged rocket motors.

However, an objective like rocket nozzle erosion cannot be analyzed in a timely fashion because of the detailed inspection required per frame of videotape, and the number of frames for a typical rocket motor firing. The goal of this study was to evaluate computer image measurement techniques so a process like measurement of rocket motor nozzle throat erosion can be automated for timely analysis. After evaluation of several edge detection techniques, two procedures were found to be satisfactory for this task. This study has determined that radiographic images can be measured accurately to within 0.14 inches by timely computer analysis. GRA

N88-28962# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
COMPARISON OF 2-D FOURIER AND SPATIAL TECHNIQUES FOR REMOVING NOISE IN REAL-TIME X-RAY RADIOGRAPHY Final Report, 1 Oct. 1986 - 31 Dec. 1987
David L. Carson (Tennessee Univ. Space Inst., Tullahoma.) Apr. 1988 44 p
(AD-A193700; AEDC-TR-87-37) Avail: NTIS HC A03/MF A01 CSCL 12I

When X-raying rocket propulsion systems during testing, periodic noise can corrupt the overall quality of an X-ray image. This periodic noise results from vibrations caused by the rocket firing and/or from the pulsing of the X-ray source. A method of removing band-limited noise for enhancement of real-time radiographic images of propulsion systems under test conditions is, therefore, desired to improve data analysis. This investigation compares the Fourier and spatial techniques relative to their ability to eliminate random and periodic noise. Fast Fourier transform (FFT) techniques are discussed with respect to efficiency and ease of implementation. Methods of removing low- and high-frequency and band-limited noise are demonstrated using both Fourier and spatial techniques. The radix-2 method of performing an FFT was selected for this investigation because of ease of implementation and reasonable computation time for a data transfer processor. The Fourier domain techniques were found to be better suited for removing band-limited periodic noise because extensive spatial filtering by means of frame averaging destroys the time resolution of the image. GRA

N88-28963# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.
ORBITAL PROPULSION MODULE (OPM). STUDY ON CONI-SPHERICAL SURFACE TENSION TANKS (COSTA) Final Report
W. Kleinau, H. Guenther, J. Kollien, H. Schweig, and M. Wuermseer Paris, France ESA Oct. 1987 580 p
(Contract ESTEC-6842/86-NL-PH(SC))
(MBB-URV-170/87; ESA-CR(P)-2556; ETN-88-92917) Avail: NTIS HC A25/MF A01

The technical feasibility of an Orbital Propulsion Module (OPM) comprising coni-spherical surface tension tanks, attached to a heavy satellite (Spacebus 400, mass in GEO = 1600 kg BoM) for launch by Ariane 44L was investigated. The OPM (having a bipropellant mass capability of nominal 2900 kg) consists of a load-carrying primary structure, and of 4 propellant and 2 pressure-gas tanks, supported by a secondary structure. A 3 kN pressure-gas-fed engine is assumed as the main transfer engine. Coni-spherical propellant tanks, polar mounted, were compared with spherical tanks, equatorial mounted. Both tank types are equipped with surface tension zero-g propellant management devices. The applicability of the super plastic forming (SPF) process compared to a forging process for this propellant tank size (1100 mm dia) was studied. Concerning the primary structure, a truss-framework structure was analyzed versus a sandwich-shell structure. The favorable OPM-candidate for the medium/longer term future comprises coni-spherical propellant tanks, SPF-processed and polar nounted, and a truss framework structure connecting the heavy spacecraft to the launcher. ESA

N88-28964*# Aerojet Strategic Propulsion Co., Sacramento, Calif.
SRB/SLEEC (SOLID ROCKET BOOSTER/SHINGLE LAP EXTENDIBLE EXIT CONE) FEASIBILITY STUDY, VOLUME 1 Final Report, 23 Sep. 1985 - 19 Sep. 1986
William H. Baker, Jr. 19 Sep. 1986 185 p
(Contract NAS8-36571)
(NASA-CR-178973; NAS 1.26:178973; SRB-CLE-F-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 21H

A preliminary design and analysis was completed for a SLEEC (Shingle Lap Extendible Exit Cone) which could be incorporated on the Space Transportation System (STS) Solid Rocket Booster (SRB). Studies were completed which predicted weights and performance increases and development plans were prepared for the full-scale bench and static test of SLEEC. In conjunction with the design studies, a series of supporting analyses were performed to assure the validity and feasibility of performance, fabrication, cost, and reliability for the selected design. The feasibility and required amounts of bench, static firing, and flight tests considered necessary for the successful incorporation of SLEEC on the Shuttle SRBs were determined. Preliminary plans were completed which define both a follow on study effort and a development program. Author

N88-28965*# Aerojet Strategic Propulsion Co., Sacramento, Calif.
SRB/SLEEC (SOLID ROCKET BOOSTER/SHINGLE LAP EXTENDIBLE EXIT CONE) FEASIBILITY STUDY, VOLUME 2. APPENDIX A: DESIGN STUDY FOR A SLEEC ACTUATION SYSTEM Final Report, 23 Sep. 1985 - 19 Sep. 1986
D. S. Thompson 19 Sep. 1986 118 p Prepared in cooperation with Garrett Corp., Tempe, Ariz.
(Contract NAS8-36571)
(NASA-CR-178974; NAS 1.26:178974; SRB-CLE-F-Vol-2-App-A)
Avail: NTIS HC A06/MF A01 CSCL 21H

The results are presented of a design feasibility study of a self-contained (powered) actuation system for a Shingle Lap Extendible Exit Cone (SLEEC) for Transportation System (STS). The evolution of the SLEEC actuation system design is reviewed, the final design concept is summarized, and the results of the detailed study of the final concept of the actuation system are treated. A conservative design using proven mechanical components was established as a major program priority. The final mechanical design has a very low development risk since the components, which consist of ballscrews, gearing, flexible shaft drives, and aircraft cables, have extensive aerospace applications and a history of proven reliability. The mathematical model studies have shown that little or no power is required to deploy the SLEEC actuation system because acceleration forces and internal pressure from the rocket plume provide the required energies. A speed control brake is incorporated in the design in order to control the rate of deployment. E.R.

N88-29375*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERT SYSTEMS FOR MSFC POWER SYSTEMS
David J. Weeks *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 215-226 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 10B

23 CHEMISTRY AND MATERIALS (GENERAL)

N88-28966*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THIN FILM COATINGS FOR SPACE ELECTRICAL POWER SYSTEM APPLICATIONS
Daniel A. Gulino Sep. 1988 16 p Presented at the 2nd International Conference on Surface Modification Technologies,

Chicago, Ill., 25-28 Sep. 1988; sponsored in part by The Metallurgical Society of AIME
(NASA-TM-101325; E-4336; NAS 1.15:101325) Avail: NTIS HC A03/MF A01 CSCL 07C

This paper examines some of the ways in which thin film coatings can play a role in aerospace applications. Space systems discussed include photovoltaic and solar dynamic electric power generation systems, including applications in environmental protection, thermal energy storage, and radiator emittance enhancement. Potential applications of diamondlike films to both atmospheric and space based systems are examined. Also, potential uses of thin films of the recently discovered high-temperature superconductive materials are discussed.
Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N88-28967# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
ELASTIC WAVE DISPERSION IN LAMINATED COMPOSITE PLATE
Subhendu K. Datta, Arvind H. Shah (Manitoba Univ., Winnipeg.), Y. Al-Nassar, and R. L. Bratton Jul. 1987 8 p
(Contract N00014-86-K-0280)
(AD-A192289; CUMER-87-2) Avail: NTIS HC A02/MF A01 CSCL 11D

The stiffness method is used to study dispersion of waves in a laminated plate. In this approach each lamina is divided into several sublayers and the displacement distribution through the thickness of each sublayer is approximated by polynomial interpolation functions in such a way that displacements and tractions are continuous across the interfaces between adjacent sublayers. The pertinent equations are summarized and numerical results obtained for particular systems discussed. This study is motivated by a desire to model wave propagation in a continuous fiber-reinforced laminated plate. If the wavelength is long compared to the fiber diameters and spacing, then each lamina can be modeled as a homogeneous transversely isotropic medium with the symmetry axis parallel to the fibers. The overall effective elastic properties of such a medium can be calculated from the fiber and matrix properties by using an effective modulus theory. Such an assumption has been made in this paper. Thus the dispersion characteristics of guided waves in a layered anisotropic plate is studied. GRA

N88-28968# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering.
A COMPREHENSIVE STUDY ON DAMAGE TOLERANCE PROPERTIES OF NOTCHED COMPOSITE LAMINATES Final Technical Report, 30 Sep. 1984 - 31 Dec. 1987
A. S. Wang, E. S. Reddy, W. Binienda, and U. Zhong Feb. 1988 254 p
(Grant AF-AFOSR-0334-84)
(AD-A192952; AFOSR-88-0280TR) Avail: NTIS HC A12/MF A01 CSCL 11D

This final report contains the results of an investigation on matrix related damage mechanisms in notched composite laminates. The theoretical approach taken follows the principles of micromechanisms and the mechanics of brittle fracture at the descriptive level considered valid for the so-called ply elasticity. Namely, the laminate is basically treated as a three-dimensional elastic solid which is made of distinctly anisotropic layers. Brittle fracture can initiate and propagate within any layer having a weaker axis of material anisotropy, and within any one of the weaker layer interfaces due to the three-dimensional interlaminar stresses. Owing to the particular microstructure of the laminate, growth of such sublaminate cracks constitutes a load or time dependent evolutionary process. A computer simulation methodology is developed to describe the modes and the extent of damage caused initially by the presence of the notch, and subsequently by the damages themselves. An experiment using a graphite epoxy laminate is then conducted to validate the simulation results.
Author

N88-28969# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France). Service Evaluation des Materiaux.
NONDESTRUCTIVE TESTS AND HIGH PERFORMANCE COMPOSITE STRUCTURES [ESSAIS NON DESTRUCTIFS ET STRUCTURES COMPOSITES]
F. Albugues 1988 17 p In FRENCH
(SNIAS-881-430-119; ETN-88-92867) Avail: NTIS HC A03/MF A01

The most efficient nondestructive test methods applicable to high performance carbon or kevlar reinforced plastics are reviewed including the hard X or gamma radiation methods such as X-ray tomography, neutron photography and Compton scattered diffusion, holographic methods, acoustic emission methods, and microwaves. The examples show that each method has a definite area of application. ESA

N88-28970# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE EFFECTS OF MOISTURE LOSS AND ELEVATED TEMPERATURE UPON THE MATERIAL DAMPING OF FIBRE REINFORCED POLYMER MATRIX COMPOSITES Thesis
William Donald Morison Jul. 1988 315 p
(UTIAS-324; ISSN-0082-5255) Copyright Avail: NTIS HC A14/MF A01

A phenomenologically-based laminate constitutive model is developed to evaluate the material damping of non-aging fiber reinforced polymer matrix composites. The influences of elevated temperature and vacuum induced moisture loss are incorporated implicitly through the use of a reduced frequency approach. Accompanying analysis for the evaluation of effective dynamic moduli and other dynamic material constants is derived for the particular case of a cantilever beam in free vibration decay. Analytical expressions are derived for significant systematic errors and are applied to the data prior to final correlation. A semi-automated, carousel-based test facility and data analysis system is developed and integrated with an existing thermal-vacuum chamber to generate data for model verification.
Author

N88-28971# Israel Atomic Energy Commission, Yavneh. Nuclear Research Centre.
SPALLATION AND DYNAMIC FRACTURE AS AN EFFECT OF LASER INDUCED SHOCK-WAVES Report No. 2, 2 Sep. 1987 - 2 Jan. 1988
David Salzmann and Gilath, Irith 2 Jan. 1988 8 p
(Contract DAJA45-87-C-0032)
(AD-A193513) Avail: NTIS HC A02/MF A01 CSCL 19I

The main activities during the last four months of this contract were devoted to a detailed design of the mainstream of the experiments and the purchase of carbon-carbon composite targets with appropriate specifications for these experiments. Some preliminary experiments were carried out on 3-D C-C targets to get some initial quantitative information about the range of laser intensities required to cause damage to these materials. GRA

N88-28972# Naval Postgraduate School, Monterey, Calif.
EFFECT OF FIBER DIAMETER ON THE RELIABILITY OF COMPOSITES - AUTOMATED LASER DIFFRACTION IMPLEMENTATION M.S. Thesis
Jeffrey S. Kunkel Dec. 1987 118 p
(AD-A193524) Avail: NTIS HC A06/MF A01 CSCL 11D

Composite failures are microscopically sequential and locally redundant. As a result, a composite's structure reliability and its strength dependency on geometric size is intimately dependent on the statistics of fiber filament strength. A composite reliability model is needed to utilize such inherent materials redundancy in

structural design. This investigation first establishes the important role of fiber diameter measurement in the characterization of fiber filament strength statistics and the composite reliability function, and second, implements the diameter measurement by laser diffraction. This method is automated and lends itself to industrial adoption for materials development, acceptance and quality control. GRA

N88-28973# Georgia Inst. of Tech., Atlanta.
ULTRAFINE MICROSTRUCTURE COMPOSITES PREPARED BY CHEMICAL VAPOR DEPOSITION Annual Report, Jan. - Dec. 1987
W. J. Lackey, Garth B. Freeman, Arlynn W. Smith, John R. Thompson, and Geoving J. Gerard Dec. 1987 33 p
(Contract N00014-87-K-0036)
(AD-A193849; GTRI-A-4699-1) Avail: NTIS HC A03/MF A01 CSCL 11D

It is our goal to develop an analytical model which predicts the experimental conditions which permit the preparation of ultrafine microstructure ceramic composites by chemical vapor deposition (CVD). The model is to be based on classical thermodynamics, mass transport, kinetic, nucleation, and growth theory. The model will be validated for two dispersed phase composite systems. One system will be boron nitride plus aluminum nitride. The other will be hafnium diboride plus silicon carbide. The BN + AlN system is of interest for radomes, windows, and tribological applications, while HfB(sub 2) + SiC offers potential as a high temperature oxidation resistant material, including oxidation protective coatings for carbon-carbon composites. Thermodynamic analyses of the BN + AlN and the HfB(sub 2) + SiC systems have been completed. These computerized studies indicate that both composite systems can be prepared by codeposition using commercially available, conventional reagents. GRA

N88-28974# Dayton Univ., Ohio. Materials Lab.
MOLECULAR COMPOSITES PROCESSING AND PROPERTIES, 1 Final Report, May 1985 - Apr. 1986
Charles C. Lee, T. E. Helminiak, and H. Chuah Jan. 1988 73 p
(Contract F33615-84-C-5020)
(AD-A194113; AFWAL-TR-87-4127) Avail: NTIS HC A04/MF A01 CSCL 11D

This report identifies a new approach to processing thick molecular composites by non-melt consolidation. The process involves the coagulation of the PBT/Nylon 66 dope from methane sulfonic acid into a block of required dimensions using a specially designed mold. The coagulant diffused into the mold through a porous stainless steel plate while a constant pressure is applied to contain the volume changes during coagulation, thus giving a void-free coagulated block. Further consolidation was carried out in a press. The coagulation process was also accompanied by a study of the diffusion of coagulant into the dope. A power law relationship was established experimentally between the time required for coagulation and thickness of the dope. The experimental results were applied to the new coagulation process described above. Morphology study showed that if large voids are formed during coagulation, phase separated domains of 1 to 10 micrometer size appeared on the void surface. Other scouting studies using steam as coagulant, multi-layer coatings and spraying dopes as droplets for fast coagulation were also reported. GRA

N88-28975# Delaware Univ., Newark. Dept. of Mechanical Engineering.
AN INVESTIGATION OF SOME BASIC PROPERTIES OF HYBRID COMPOSITE MATERIALS Final Report, 1 Nov. 1983 - 31 Oct. 1987
Tsu-Wei Chou 25 Mar. 1988 9 p
(Contract DAAG29-83-K-0170)
(AD-A194136; ARO-20614.1-EG) Avail: NTIS HC A02/MF A01 CSCL 11D

This final report presents the major findings of research for the investigation of some basic properties of hybrid composite materials. The topics covered in this study were: (1) statistical strength theory of continuous fiber composites; (2) non-linear stress strain behavior of hybrid composites; (3) two-dimensional fabric composites: 3.1 woven hybrid composites, 3.2 notched strength of woven fabric composites with molded-in holes, 3.3 friction and wear of advanced thermoplastic composites, 3.4 impact behavior and damage tolerance of woven carbon fiber reinforced advance thermoplastic composites; (4) flexural and axial compressible failures of three-dimensionally braided composite I-beams; and (5) three-dimensional analysis of transient interlaminar thermal stress of cross-ply composites. GRA

N88-28976# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Micro-Ondes.
MICROWAVE FREQUENCY NONDESTRUCTIVE CONTROL Final Report [CONTROLE NON DESTRUCTIF PAR HYPERFREQUENCE]
A. Priou and A. Assice Jul. 1987 34 p In FRENCH
(Contract DRET-86-002-09)
(CERT-2/1355-MO; ETN-88-92888) Avail: NTIS HC A03/MF A01

The feasibility of microwave frequency nondestructive control of composite materials is studied. An external radiation source and a radiometer were used. The analysis was made applying the parallel layers theory and the radiative transfer method. A good agreement between theoretical and experimental results is found. The potential and future development of this technique are discussed. ESA

N88-28977# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
CONTRIBUTION TO THE STUDY OF MATERIALS BEHAVIOR IN SPACE ENVIRONMENT
P. Plotard and F. Albugues 1988 9 p
(SNIAS-881-430-104; ETN-88-92852) Avail: NTIS HC A02/MF A01

Facilities to study dimensional stability and for nondestructive in situ analysis of spacecraft materials and components are described. The simulation takes into account solar UV, vacuum, temperature, thermal cycle, and particle effects, with computed dose evaluation corresponding to selected orbits. Results for kevlar and carbon with epoxy resin matrix composites are presented. ESA

N88-28978# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
VERY HIGH TEMPERATURE MATERIALS FOR MECHANICAL APPLICATION
V. L. Magret and A. Horbonneau 1988 5 p
(SNIAS-881-430-106; ETN-88-92854) Avail: NTIS HC A02/MF A01

Ceramic composite materials which demonstrate temperature resistance up to 1400 C, and oxidation resistant carbon-carbon with coating adapted to service temperature were developed for space use. Base on experience in weaving and densification, demonstration parts were manufactured. ESA

N88-28979# Dornier-Werke G.m.b.H., Oberpfaffenhofen (West Germany). Claudius Dornier Seastar.
DEVELOPMENT OF A GLASS FIBER WING FOLLOWING THE CONSTRUCTION REGULATION FAR PART 23 [ENTWICKLUNG EINES GLASFASERTRAGFLUEGELS NACH FAR PART 23]
H. Lucas 1986 31 p In GERMAN Presented at the 4th BMFT Statusseminars, Munich, Fed. Republic of Germany, 28-30 Apr. 1986
(Contract BMFT-LFK-8531)
(ETN-88-92966) Avail: NTIS HC A03/MF A01

A wing was developed for the amphibious aircraft Seastar using low pressure processing (LPP) of fiber reinforced plastics. The fundamentals and the development of the LPP technique are outlined. The technical and economic advantages of the LPP technique are explained. The application of the LPP construction

method to aircraft following the regulation FAR Part 23 is outlined. It is shown that the LPP technique fulfils regulation requirements and is suited for any type of high quality vehicle cell. ESA

N88-28980*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF A SiC/Ti-24Al-11Nb COMPOSITE
P. K. Brindley, P. A. Bartolotta, and S. J. Klima 1988 30 p Presented at the 117th TMS-AIME Annual Meeting, Phoenix, Ariz., 25-29 Jan. 1988; sponsored by the American Society for Metals
(NASA-TM-100956; E-4253; NAS 1.15:100956) Avail: NTIS HC A03/MF A01 CSCL 11D

A summary of ongoing research on the characterization of a continuous fiber reinforced SiC/Ti-24Al-11Nb (at percent) composite is presented. The powder metallurgy fabrication technique is described as are the nondestructive evaluation results of the as-fabricated composite plates. Tensile properties of the SiC fiber, the matrix material, and the 0-deg SiC/Ti-24Al-11Nb composite (fibers oriented unidirectionally, parallel to the loading axis) from room temperature to 1100 C are presented and discussed with regard to the resultant fractography. The as-fabricated fiber-matrix interface has been examined by scanning transmission electron microscopy and the compounds present in the reaction zone have been identified. Fiber-matrix interaction and stability of the matrix near the fiber is characterized at 815, 985, and 1200 C from 1 to 500 hr. Measurements of the fiber-matrix reaction, the loss of C-rich coating from the surface of the SiC fiber, and the growth of the Beta depleted zone in the matrix adjacent to the fiber are presented. These data and the difference in coefficient of thermal expansion between the fiber and the matrix are discussed in terms of their likely effects on mechanical properties. Author

N88-28981*# University of Southern California, Los Angeles. Dept. of Materials Science.
THE HIGH TEMPERATURE CREEP DEFORMATION OF SI3N4-6Y2O3-2Al2O3
J. A. Todd and Zhi-Yue Xu 1988 32 p
(Grant NAG3-685)
(NASA-CR-183204; NAS 1.26:183204) Avail: NTIS HC A03/MF A01 CSCL 11D

The creep properties of silicon nitride containing 6 wt percent yttria and 2 wt percent alumina have been determined in the temperature range 1573 to 1673 K. The stress exponent, n, in the equation epsilon dot varies as sigma sup n, was determined to be 2.00 + or - 0.15 and the true activation energy was found to be 692 + or - 25 kJ/mol. Transmission electron microscopy studies showed that deformation occurred in the grain boundary glassy phase accompanied by microcrack formation and cavitation. The steady state creep results are consistent with a diffusion controlled creep mechanism involving nitrogen diffusion through the grain boundary glassy phase. Author

N88-28982*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FINITE ELEMENT COMPOSITE ANALYSIS PROGRAM (FECAP) FOR A MICROCOMPUTER
David E. Bowles Jul. 1988 34 p
(NASA-TM-100670; NAS 1.15:100670) Avail: NTIS HC A03/MF A01 CSCL 11D

A special purpose finite element composite analysis program for analyzing composite material behavior with a microcomputer is described. The formulation assumes a state of generalized plane strain in a material consisting of two or more orthotropic phases. Loading can be mechanical and/or thermal. The theoretical background, computer implementation, and program users guide are described in detail. A sample program is solved showing the required user input and computer generated output. Author

N88-28983*# Douglas Aircraft Co., Inc., Long Beach, Calif.
CRITICAL JOINTS IN LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES. VOLUME 1: TECHNICAL SUMMARY Final Report
Bruce L. Bunin Sep. 1985 64 p
(Contract NAS1-16857)
(NASA-CR-3914; NAS 1.26:3914; ACEE-26-FR-3504) Avail: NTIS HC A04/MF A01 CSCL 11D

A program was conducted at Douglas Aircraft Company to develop the technology for critical joints in composite wing structure that meets all the design requirements of a 1990 commercial transport aircraft. In fulfilling this objective, analytical procedures for joint design and analysis were developed during Phase 1 of the program. Tests were conducted at the element level to supply the empirical data required for methods development. Large composite multirow joints were tested to verify the selected design concepts and for correlation with analysis predictions. The Phase 2 program included additional tests to provide joint design and analysis data, and culminated with several technology demonstration tests of a major joint area representative of a commercial transport wing. The technology demonstration program of Phase 2 is discussed. The analysis methodology development, structural test program, and correlation between test results and analytical strength predictions are reviewed. Author

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-28984# Lawrence Livermore National Lab., Calif.
THERMODYNAMIC DATA BASES FOR MULTIVALENT ELEMENTS: AN EXAMPLE FOR RUTHENIUM
J. A. Rard Nov. 1987 29 p Presented at the International Conference on Thermodynamics of Aqueous Systems With Industrial Applications, Warrenton, Va., 10 May 1987
(Contract W-7405-eng-48)
(DE88-004395; UCRL-96555-Rev-1; CONF-870594-1-Rev-1)
Avail: NTIS HC A03/MF A01

A careful consideration and understanding of fundamental chemistry, thermodynamics, and kinetics is absolutely essential when modeling predominance regions and solubility behavior of elements that exhibit a wide range of valence states. Examples of this are given using the ruthenium-water system at 298.15 K, for which a critically assessed thermochemical data base is available. Ruthenium exhibits the widest range of known aqueous solution valence states. Known solid anhydrous binary oxides of ruthenium are crystalline RuO2, RuO4, and possibly RuO3 (thin film), and known hydroxides/hydrated oxides (all amorphous) are Ru(OH)3.H2O, RuO2.2H2O, RuO2.H2), and a poorly characterized Ru(V) hydrous oxide. Although the other oxides, hydroxides, and hydrous oxides are generally obtained as precipitates from aqueous solutions, they are thermodynamically unstable with regard to RuO2(cr) formation. Characterized aqueous species of ruthenium include RuO4 (which slowly oxidizes water and which dissociates as a weak acid), RuO4(-), RuO4(-2), which probably contains lesser amounts of RuO3(OH)2(-) and RuO3(OH)2(-2), respectively, and other species), Ru(OH)2(+2), Ru4(OH)12(+4), Ru(OH)4, Ru(+3), Ru(OH)(+2), Ru(OH)2(+), Ru(+2) and some hydroxytetramers with formal ruthenium valences of 3.75 greater than or equal to Z greater than or equal to 2.0. Potential pH diagrams of the predominance regions change significantly with concentration due to polymerization/depolymerization reactions. Failure to consider the known chemistry of ruthenium can yield large differences in predicted solubilities. DOE

N88-28985 Carnegie-Mellon Univ., Pittsburgh, Pa.
COMBUSTION DYNAMICS AND THERMAL STRUCTURE OF A PLANAR SPRAY FLAME Ph.D. Thesis
Mardson Queiroz 1987 196 p
Avail: Univ. Microfilms Order No. DA8725975

An experimental exploration of the dynamic nature of the burning phenomenon and of the thermal structure of a planar spray flame

was performed. Initially, the influence of important spray parameters on the flame front was investigated. Subsequently, the performance of micro-thermocouples for the measurement of gas-phase temperature in the presence of droplets was studied as a means to analyze the thermal structure of the planar spray flame. Finally the influence of important spray parameters on the thermal structure of the flame was investigated. Dissert. Abstr.

N88-28986# Wisconsin Univ., Milwaukee. Lab. of Surface Studies.
LOW TEMPERATURE FILM GROWTH OF THE OXIDES OF ZINC, ALUMINUM AND VANADIUM (AND RELATED SYSTEMS, OXIDES OF GOLD AND GERMANIUM, NITRIDES OF ALUMINUM AND TUNGSTEN) BY REACTIVE SPUTTER DEPOSITION Final Report, 1 Jul. 1984 - 31 Dec. 1987
Carolyn R. Aita Feb. 1988 140 p
(Contract DAAG29-84-K-0126)
(AD-A193497; ARO-21334.19-MS) Avail: NTIS HC A07/MF A01 CSCL 07D

The research involved investigation of process parameter growth environment film property relationships for various binary oxide and nitride films grown on unheated substrates by reactive sputter deposition using an elemental target. In situ optical emission spectroscopy and glow discharge mass spectrometry were used to determine gas phase species in the plasma volume. A battery of techniques was used to characterize (post-deposition) film crystallography, chemistry, microstructure, electrical resistivity, and optical behavior. GRA

N88-28987# Los Alamos National Lab., N. Mex.
RAMAN SPECTROSCOPY ON SIMPLE MOLECULAR SYSTEMS AT VERY HIGH DENSITY
D. Schiferl, R. S. LeSar, and D. S. Moore 1988 27 p Presented at the NATO Advanced Study Institute on Simple Molecular Systems at Very High Densities, Les Houches, France, 29 Mar. 1988
(Contract W-7405-eng-36)
(DE88-010947; LA-UR-88-1671; CONF-880372-4) Avail: NTIS HC A03/MF A01

Raman spectroscopy of simple molecular substances at high pressures is described. Raman spectroscopy is one of the most powerful tools for studying these substances. It is often the quickest means to explore changes in crystal and molecular structures, changes in bond strength, and the formation of new chemical species. Raman measurements have been made at pressures up to 200 GPa (2 Mbar). Even more astonishing is the range of temperatures (4 to 5200 K) achieved in various static and dynamic (shock-wave) pressure experiments. One point to be emphasized is the need for a good theoretical understanding to properly interpret and use experimental results. This is particularly true at ultra-high pressures, where strong crystal field effects can be misinterpreted as incipient insulator-metal transitions. Noteworthy apparatus, techniques, and results are pointed out. Also included is some of the oral tradition of high pressure Raman spectroscopy and useful little things that rarely or never appear in print. Because this field is rapidly expanding, a number of exciting new techniques is discussed that have been informally communicated, especially those that seem to open new possibilities. that rarely or never appear in print. Because this field is rapidly expanding, we discuss a number of exciting new techniques that have been informally communicated to us, especially those that seem to open new possibilities. DOE

N88-28988# Sandia National Labs., Albuquerque, N. Mex.
SOL-GEL KINETICS: Si(SUP)29 NMR AND A STATISTICAL REACTION MODEL
R. A. Assink and B. D. Kay 1988 6 p Presented at the BES/Materials Science Program Review, Albuquerque, N. Mex., 27 Jun. 1988
(Contract DE-AC04-76DP-00789)
(DE88-011545; SAND-88-1518C; CONF-8806138-1) Avail: NTIS HC A02/MF A01

Sol-gel processes allow one to prepare novel materials at low processing temperatures. A detailed understanding of the chemical kinetics of such systems is important to fully exploit the unique features of sol-gel processing. This paper describes a systematic approach to the study of sol-gel kinetics which employs Si29 NMR spectroscopy and kinetic modelling techniques. DOE

N88-28989# Yale Univ., New Haven, Conn. Dept. of Chemistry.
HYDROGEN STORAGE BY MOLECULAR POLYHYDRIDES Report, 1 Apr. 1984 - 30 Nov. 1987
R. H. Crabtree 1 Nov. 1987 7 p
(Contract DAAG29-84-K-0035)
(AD-A194207; ARO-20770.2-CH) Avail: NTIS HC A02/MF A01 CSCL 07B

We set out to discover whether molecular polyhydrides would be effective hydrogen storage agents. This three year period has taught us about some very unexpected new aspects of these complexes. We have shown that far from being a rare binding mode, dihydrogen binding occurs without breaking the H-H bond in a wide variety of polyhydrides. These had previously been assumed to have classical structures with all M-H bonds. Not only does H2 bind, but it also dissociates rapidly and reversibly in certain of these nonclassical hydrides. We now find that this complex selectively transports H2 through an organic solvent. Membrane transport is not only an important problem from the biological point of view but it has interesting commercial implications. It is very likely that the rapid and reversible binding could be employed in hydrogen storage. GRA

N88-28990# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
INFRARED DETECTION USING RYDBERG ATOMS Final Report, 1 Mar. 1979 - 30 Nov. 1987
Daniel Kleppner Apr. 1988 6 p
(Contract N00014-79-C-0183)
(AD-A194308) Avail: NTIS HC A02/MF A01 CSCL 07D

This is the final report on a program of research on Rydberg atoms and radiation. The goal of the program was to use Rydberg atoms to explore new types of fundamental radiative phenomena. As demonstrated by the research generated by this line of inquiry in laboratories in the U.S. and abroad, the program has been successful. A new area of study has been come to be called Cavity Quantum Electrodynamics has emerged in the last few years. Research under this grant on inhibited spontaneous emission is often regarded as seminal in that development. The Principal Investigator was awarded the 1986 Davisson-Germer Prize of the American Physical Society for research on Rydberg atoms in applied fields; research under this grant was central to that achievement. Early work under the grant involved developing techniques for studying radiative transfer of Rydberg atoms on a level-by level basis. black-body radiative transfer - was demonstrated shortly thereafter. Full demonstration of inhibited spontaneous emission required the development of a technique for transferring atoms to the so-called 'circular' Rydberg states. These are states of the highest possible angular momentum for a given principal quantum number. GRA

N88-28991# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
CORRELATIONS BETWEEN WETTABILITY AND STRUCTURE IN MONOLAYERS OF ALKANETHIOLS ADSORBED ON GOLD Interim Technical Report No. 7
Colin D. Bain and George M. Whitesides May 1988 15 p
(Contract N00014-85-K-0898)
(AD-A194348) Avail: NTIS HC A03/MF A01 CSCL 07D

Long-chain alkanethiols absorb onto gold from solution and from monolayers. Coadsorption of HS(CH2)11OH and HS(CH2)21CH3 from ethanolic solutions of varying composition generates monolayers, the wettability of which is correlated closely with the composition of the monolayer. Absorption of the longer chain thiol is preferred over the short chain, and formation of

monolayers comprising predominantly one component is favored over mixed monolayers containing both component thiols. GRA

N88-28992# Arizona Univ., Tucson. Dept. of Chemistry.
APPLICATIONS OF CHARGE TRANSFER DEVICES IN SPECTROSCOPY Technical Report No. 68
Patrick M. Epperson, Jonathan V. Sweedler, Robert B. Bilhorn, Gary R. Sims, and M. Bonner Denton 4 Feb. 1988 33 p
(Contract N00014-86-K-0316)
(AD-A194408) Avail: NTIS HC A03/MF A01 CSCL 07D

This article discusses the use of charge transfer devices (CTDs) in spectroscopy. This paper focuses on the spectroscopic applications of CTDs. A brief history of the development of these detectors and their application in scientific imaging is presented. The use of CTDs in spectroscopy is illustrated by four applications in challenging areas of ultraviolet-visible spectroscopy. GRA

N88-28993# Arizona Univ., Tucson. Dept. of Chemistry.
HIGH PERFORMANCE CHARGE TRANSFER DEVICE DETECTORS Technical Report No. 64
Jonathan V. Sweedler, Robert B. Bilhorn, Gary R. Sims, M. Bonner Denton, and Patrick M. Epperson 4 Feb. 1988 32 p
(Contract N00014-86-K-0316)
(AD-A194409) Avail: NTIS HC A03/MF A01 CSCL 09A

This article is the first in a two-part series describing charge transfer devices (CTDs) -- a relatively new class of multichannel detectors for the ultraviolet to near-infrared spectral regions. An overview of the operation and the characteristics of CTDs relevant to analytical spectroscopy is presented. The sensitivity and dynamic range obtainable from CTD detectors are discussed and compared to the sensitivity and dynamic range obtainable from other spectroscopic detectors. Unique capabilities such as the ability to nondestructively readout the detector array and the ability to alter the effective detector element size using the process of binning are described. Detector array formats ranging from single elements to extremely large arrays, large photoactive areas, high quantum efficiencies, dark count rates allowing long integration times and low read noises all contribute to the outstanding performance and great flexibility offered by CTDs. GRA

N88-28994# Tel-Aviv Univ. (Israel). Dept. of Mechanical Engineering.
SMALL SCALE MIXING IN THE INITIAL REGION OF A JET Final Report, 1985 - 1986
Ephraim Gutmark and I. Wygnanski 1986 43 p
(Grant AF-AFOSR-0278-85)
(AD-A193500) Avail: NTIS HC A03/MF A01 CSCL 07D

The possibility of achieving substantial mixing enhancement, using noncircular nozzles, was demonstrated. It was shown that nozzle geometries containing sharp corners are beneficial for mixing purposed. By breaking the inital symmetry of the flow, one may also reduce the coherence of the large structures, thus eliminating the main causes for the onset of combustion instabilities. The excitation of azimuthal instabilities increases the mixing at the higher frequency range. The considerable variation of the mean velocity distribution around the jet, especially near the corners, results in a rapid decrease of the azimuthal cross-correlation near these sections. When such cross-correlation is decomposed into aximuthal modes, higher modes are shown to be present. The higher modes are responsible for the increase in the three-dimensionality of the flow, the turbulence level, and the small scale activity. GRA

N88-28995# Purdue Univ., West Lafayette, Ind.
SUPER HYDRIDES Final Report, 15 Mar. 1985 - 14 Mar. 1988
Herbert C. Brown Mar. 1988 27 p
(Contract DAAG29-85-K-0062)
(AD-A193710; ARO-22382.2-CH) Avail: NTIS HC A03/MF A01 CSCL 07C

The discovery of metal hydride reducing reagents has without exaggeration revolutionized the reduction of functional groups in organic chemistry. In the last decade or so asymmetric synthesis has emerged from the cold to vie quite successfully with enzymes as a means of incorporating chirality in prostereogenic centers. This research is at the forefront of this second revolution in organic chemistry. During the course of the research for the period covered in this Final Report, tremendous leaps forward have been made, both in developing new chiral reducing reagents and in understanding their mode of reaction. In this regard we have concentrated our efforts in two major areas: (1) Chiral trialkylboranes, and (2) Chiral borohydrides. In the first case we have discovered the extremely versatile and readily accessible asymmetric reducing reagent, diisopinocampheylchloroborane, Ipc2BCl, derivable from alpha-pinene of either antipode. Our success with Ipc2BCl in transferring stereogenicity to alcohols encouraged us to explore further modifications of the alpha-pinene moiety as useful chiral directors. GRA

N88-28996# North Carolina State Coll., Raleigh. Dept. of Chemistry.
CHARGE STORAGE AND SWITCHING PHENOMENA IN METAL COMPLEXES Final Report, 14 Feb. 1986 - 31 Dec. 1987
M. K. DeArmond, K. W. Hanck, and D. W. Wertz 14 Mar. 1988 3 p
(Contract DAAL03-86-K-0040)
(AD-A193778; ARO-22741.3-CH) Avail: NTIS HC A02/MF A01 CSCL 07D

The purpose of this research is to identify intramolecular charge separation and charge localization phenomena that can when incorporated into polymer materials provide the basis for molecular switching phenomena. The first year and a half of this work has been spent designing monomer molecules possessing unusual photophysical properties and determining the physical measurement technique to be exploited with the polymers. A unique multiple emitting Ru(2) compound containing the 2,2-dipyridylamine ligand has been identified and the photophysical properties measured. GRA

N88-28997# State Univ. of New York, Buffalo. Dept. of Chemistry.
ELECTRONIC STATES OF THE Xe(SUB n)HCl SYSTEMS IN GAS AND CONDENSED PHASES
Isidore Last and Thomas F. George May 1988 37 p Submitted for publication
(Contract N00014-86-K-0043)
(AD-A193881; UBUFFALO/DC/88/TR-68) Avail: NTIS HC A03/MF A01 CSCL 07B

Systems formed by one Cl, one H and one or several Xe atoms are considered by the semiempirical diatomics-in-ionic-systems method, which takes into account the charge delocalization in ionic states and the coupling between the neutral and ionic states. Calculations are performed both for gas-phase systems, such as van der Waals complexes and clusters of Xe(sub n)HCl (n = 1,2,4,8,12) and ionic molecules (HXe(sub n))Cl, and for systems formed in Xe solids doped by HCl molecules. The calculations give the structure of the systems, dissociation energies and energies of electronic transitions. The calculations show, in particular, the existence of the ground-state ionic molecule (HXe)Cl, the decrease of the HCl electronic excitation energy in clusters and solids, and the increase of the emission photon energy of the ionic HXe(sub n)Cl systems as compared to the Xe(sub n)Cl molecule. GRA

N88-28998# Ballistic Research Labs., Aberdeen Proving Ground, Md.
COMBUSTION STUDIES OF ACOUSTICALLY SUSPENDED LIQUID DROPLETS
Mar. 1988 45 p
(AD-A193892; BRL-CR-594) Avail: NTIS HC A03/MF A01 CSCL 20A

A piezoelectrically driven ultrasonic resonator was developed and tested in this study. The device was used to levitate liquid fuel droplets for evaporation measurements and ignition studies. The final report describes the resonator and its operating characteristics, gives a brief review of the literature, and presents

the results of various ignition tests. No successful minimum perturbation ignition method was discovered among the several explored. It is the author's opinion that the acoustic levitation technique may hold some promise for conducting non-combustion related droplet measurements, for example evaporation tests, but without further development of the technique combustion experiments will be difficult to accomplished. Minimum developmental needs will be for a high temperature, high pressure chamber and a feedback positioning controller. However, even with such additional features there is some doubt whether stable levitation of a burning droplet can occur. GRA

N88-28999# Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica.

MEASURE OF HYDROGEN CONCENTRATION PROFILE IN MATERIALS BY RESONANT NUCLEAR REACTIONS [MEDIDA DE PERFIL DE CONCENTRACAO DE HIDROGENIO EM MATERIALS POR REACAO NUCLEAR RESSONANTE]

R. P. Livi, F. C. Zawislak, and J. C. Acquadro 1986 6 p In PORTUGESE Presented at the Meeting About Gases in Metals and Alloys, Sao Carlos, Brazil, 24 Sep. 1986

(DE88-702599; INIS-BR-1015; CONF-8609421) Avail: NTIS HC A02/MF A01

The technique for determining the profile of hydrogen concentration in proximity of the surface of materials is presented. The preliminary measurements were done using the Pelletron accelerator at Sao Paulo University (Brazil) for the resonant-nuclear reaction H-1(F-19, alpha gamma)O-16. By using this reaction the technique is sensitive for concentrations above 500 ppm, which could be reduced to 100 ppm through special shielding and other techniques to reduce the background radiation. DOE

N88-29000# Universidade Federal de Sao Carlos (Brazil). Dept. de Engenharia de Materiais.

HYDROGEN PERMEATION THROUGH METALLIC FOILS [PERMEACAO DE HIDROGENIO ATRAVES DE FOLHAS METALICAS]

Maria Innes Basso Bernardi and Jose deAnchietaRodrigues 1987 5 p In PORTUGESE Presented at the Meeting About Gases in Metals and Alloys, Sao Carlos, Brazil, 24 Sep. 1986

(DE88-702600; INIS-BR-1016; CONF-8609421) Avail: NTIS (US Sales Only) HC A02/MF A01

The process of electrolytic permeation of hydrogen through metallic foils is studied. A double electrolytic cell, in glass, in which the two compartments of reaction are separated by a metallic foil to be studied, was built. As a direct result, the hydrogen diffusion coefficient in the metal is obtained. The hydrogen diffusion coefficients in the palladium and, in austenitic stainless steels 304 and 304 L, used in the Angra-1 reactor, were obtained. Samples of stainless steels with and without welding, were used. DOE

N88-29001# Leiden Univ. (Netherlands).

AN EXPERIMENTAL SETUP FOR THE STUDY OF POLARIZED He3 AND DILUTE He3-He4 MIXTURES Ph.D. Thesis, 4 Dec. 1986

Gerardus Arnoldus Vermeulen 1987 159 p Sponsored in cooperation with the Netherlands Organization for the Advancement of Pure Research

(Contract EEC-85100004-FR-PUO-P1)

(B8705589; ETN-88-92897) Avail: NTIS HC A08/MF A01

Properties of highly polarized liquid He3; a dilution refrigerator for use with the study of polarized liquid He3 and nuclear cooling; a continuous wave nuclear magnetic resonance spectrometer; Pomeranchuk cooling in high magnetic fields; experiments on polarized liquid He3; and a nuclear demagnetization system to cool a 6 percent He3-He4 mixture are discussed. ESA

N88-29002* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

METHOD AND DEVICE FOR DETERMINING HEATS OF COMBUSTION OF GASEOUS HYDROCARBONS Patent

Jag J. Singh, inventor (to NASA), Danny R. Sprinkle, inventor (to NASA), and Richard L. Puster, inventor (to NASA) 2 Aug. 1988 9 p Filed 24 Nov. 1986 Supersedes N87-18626 (25 - 11, p 1451)

(NASA-Case-LAR-13528-1; US-Patent-4,761,744; US-Patent-Appl-SN-933962; US-Patent-Class-364-500; US-Patent-Class-236-15-E; US-Patent-Class-364-557; US-Patent-Class-364-571; US-Patent-Class-374-36; US-Patent-Class-431-13; US-Patent-Class-431-76) Avail: US Patent and Trademark Office CSCL 21B

A method and device is provided for a quick, accurate and on-line determination of heats of combustion of gaseous hydrocarbons. First, the amount of oxygen in the carrier air stream is sensed by an oxygen sensing system. Second, three individual volumetric flow rates of oxygen, carrier stream air, and hydrocrabon test gas are introduced into a burner. The hydrocarbon test gas is fed into the burner at a volumetric flow rate, n, measured by a flowmeter. Third, the amount of oxygen in the resulting combustion products is sensed by an oxygen sensing system. Fourth, the volumetric flow rate of oxygen is adjusted until the amount of oxygen in the combustion product equals the amount of oxygen previously sensed in the carrier air stream. This equalizing volumetric flow rate is m and is measured by a flowmeter. The heat of combustion of the hydrocrabon test gas is then determined from the ratio m/n.

Official Gazette of the U.S. Patent and Trademark Office

N88-29003*# National Aeronautics and Space Administration, Washington, D.C.

DETERMINATION OF IMPURITIES IN SILICON CARBIDE BY ICP AES (INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY) AFTER COPRECIPITATION WITH LANTHANUM HYDROXIDE

Y. Harada, N. Kurata, and G. Furuno Sep. 1988 20 p Transl. into ENGLISH from Bunseki Kagaku (Japan), v. 36, no. 9, Sep. 1987 p 526-531 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-4307)

(NASA-TT-20332; NAS 1.77:20332) Avail: NTIS HC A03/MF A01 CSCL 07D

Sample decomposition and a method to separate impurities from a matrix are examined to identify the impurities in silicon carbide powder by ICP AES. This method made it possible to determine fifteen elements such as aluminum, iron, which are among the major impurities found in silicon carbide. Author

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-29004# Aptech Engineering Services, Inc., Sunnyvale, Calif.

STRESS INTENSITY FACTORS FOR CRACKED METALLIC STRUCTURES UNDER RAPID THERMAL LOADING Final Report, Aug. 1986 - May 1987

Russell C. Cipolla and Kimble J. Clark Oct. 1987 75 p

(Contract F33615-86-C-3217)

(AD-A191219; AES-8609709F-1; AFWAL-TR-87-3059) Avail: NTIS HC A04/MF A01 CSCL 20K

High intensity heating of aircraft structures can challenge the structural integrity of critical aircraft components, especially when they may contain flaws. The evaluation of flawed components requires the application of fracture mechanics wherein crack tip stress intensity factors are used to provide a quantitative means of assessing structural integrity. The primary objectives of this project were to develop an analysis method for computing stress intensity factors for severe thermal loadings of interest to the Air Force and to demonstrate the applicability of the method to small microcomputers. GRA

N88-29005# Drexel Univ., Philadelphia, Pa. Dept. of Materials Engineering.
A FUNDAMENTAL STUDY OF P/M PROCESSED ELEVATED TEMPERATURE ALUMINUM ALLOYS Annual Report, Oct. 1986 - Dec. 1987
Michael Koczak 31 Dec. 1987 3 p
(Grant AF-AFOSR-0012-87)
(AD-A192958; AFOSR-88-0305TR) Avail: NTIS HC A02/MF A01 CSCL 11F

A key ingredient in the development of high performance composite and powder processed RST materials is the understanding of the processing, structure and properties relationship. A vital part of this understanding is the independent control of material chemistry and processing coupled with the ability to exercise careful control of the temperature-time-pressure relationships during the consolidaïon of composite and powder processed structures. To this end, an equipment grant, requested for a high temperature Vacuum industries vacuum hot press for the fabrication of metal and ceramic matrix composites as well as a Lipton/MT composite curing autoclave/press for the consolidation of resin matrix and hybrid composite systems. A salient feature is the capability to produce composite and powder processed samples of sufficient dimensions so that meaningful mechanical and structural evaluations can be performed. The combined systems, i.e., vacuum hot press, autoclave and laminating press, shall provide the research faculty with this state of the art capability for processing advanced resin, ceramic and metal matrix composite structures as well as supporting ongoing programs in rapid solidification technology and ceramics. GRA

N88-29006# Sandia National Labs., Albuquerque, N. Mex.
INITIATION OF EXPLOSIVE MOLTEN ALUMINUM-WATER INTERACTIONS AT WET OR UNDERWATER SURFACES
L. S. Nelson, M. J. Eatough, and K. P. Guay 1988 12 p Presented at the 25th American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society National Heat Transfer Conference, Houston, Tex., 24 Jul. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004686; SAND-87-2761C; CONF-880724-7) Avail: NTIS HC A03/MF A01

In certain metallurgical operations, molten aluminum may inadvertently contact a wet or underwater solid surface. Occasionally, depending on the nature of the surface and contact conditions, an explosive melt-water interaction may be initiated. These interactions are sometimes attributed to the entrapment of water between the melt and the surface. Laboratory experiments are used to investigate these surface initiations. By coupling the results with the literature of boiling and bubble nucleation, we are able to propose and support a mechanism for the initiation of these vigorous interactions. The mechanism involves superheating of a thin layer of liquid water enclosed between the melt and a water-wettable solid surface, followed by explosive vaporization. Because nonwettable surfaces offer copious bubble nucleation sites, superheating is suppressed and the explosions are reduced or eliminated at hydrophobic surfaces. DOE

N88-29007# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
KINETIC OF MARTENSITIC TRANSFORMATIONS INDUCED BY HYDROGEN IN THE AUSTENITE
Sergio P. deOliveira, A. Saavedra, and P. E. V. deMiranda 1986 19 p In PORTUGUESE; ENGLISH summary Presented at the 4th Brazilian Symposium on Piping and Pressure Vessels, Salvadaor, Brazil, 28 Oct. 1986
(DE88-701623; INIS-BR-969; CONF-8610317) Avail: NTIS (US Sales Only) HC A03/MF A01

The X-ray diffractometry technique was used, with an automatic data acquisition system to determine the kinetics of hydrogen induced martensitic phase transformations in an AISI 304 austenitic stainless steel type, used in nuclear power plants. Hydrogenation was performed cathodically in a 1N sulfur acid solituion, containing 100 mgl of arsenic trioxide, at 50 C, during 2 hours and with a current density of 200 Am. It was found that the microstructure of the steel plays a role on the generation of hydrogen induced martensitic phases and surface microcrack. Both kinetics were slower on a pure-cold rolled steel. DOE

N88-29008# SRI International Corp., Menlo Park, Calif.
EVALUATION OF A DIFFUSION/TRAPPING MODEL FOR HYDROGEN INGRESS IN HIGH-STRENGTH ALLOYS Final Technical Report, 15 Mar. 1986 - 15 Mar. 1988
Bruce G. Pound 15 Apr. 1988 77 p
(Contract N00014-86-C-0233)
(AD-A194301) Avail: NTIS HC A05/MF A01 CSCL 11F

A diffusion/trapping model for hydrogen ingress was applied to three high-strength alloys, AISI 4340 Steel, Monel K500, and MP35N. The model was used with a potentiostatic double-pulse (PDP) technique, and current transient data were obtained in various electrolytes ranging in pH from 2.9 to 9.0. In all cases, the anodic charge can be analyzed as a function of charging time using an interface control model, in which the rate of hydrogen ingress is determined by the flux across the alloy interface and not by hydrogen diffusion in the alloy. The apparent rate constant for hydrogen trapping (k sub a) and the hydrogen ingress flux for each alloy were obtained using this model. The irreversible trapping constants for Monel K500 and MP35N were also evaluated from ka, but the densities of irreversible traps were three orders of magnitude smaller than the concentration of sulfur and phosphorus impurities, which were assumed to be the primary irreversible traps. The low values of the trap density are probably primarily due to sulfur and phosphorus segregated as clusters at grain boundaries. The two nickel-containing alloys, Monel K500 and MP35N, exhibited a lower flux of hydrogen across the alloy surface and a lower irreversible trapping constant than 4340 steel. The difference in both the nature of the principal irreversible traps, which were determined from the trapping constants, and the interfacial flux can be expected to contribute substantially to the difference in susceptibility. GRA

N88-29009# Ohio State Univ., Columbus.
AN INVESTIGATION INTO THE METALLURGICAL ASPECTS OF JOINING RAPIDLY-SOLIDIFIED ALUMINUM ALLOYS Final Report, Sep. 1984 - Dec. 1987
William A. Baeslack, III 1 Apr. 1988 108 p
(Contract DAAG29-84-K-0176)
(AD-A194677; ARO-20987.4-MS) Avail: NTIS HC A06/MF A01 CSCL 11F

Research performed during this program demonstrated that the metastable microstructures upon which rapidly-solidified, powder metallurgy (RS/PM) aluminum alloys depend for their unique mechanical properties can be both recreated using rapid solidification fusion welding processes and/or retained using solid-state welding processes. Alloys investigated included Al-Fe-X dispersoid-type compositions developed for superior elevated-temperature properties and Al-Li-X alloys developed for high strength and modulus and low density. Processes found to be most effective for the joining of these alloys included rapid-solidification electron beam and capacitor-discharge welding and solid-state inertia-friction and diffusion welding. Metallurgical phenomena investigated included solidification, solid-state phase transformations, defect formation and structure-property-fracture relationships. RS/PM aluminum alloys which contain low hydrogen levels, such as the inertly produced Al-8Fe-2Mo alloy, were effectively joined using the high-energy density electron-beam welding. GRA

N88-29010# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
ADVANCED PROCESSING AND PROPERTIES OF HIGH PERFORMANCE ALLOYS Technical Report No. 9, 1 Feb. - 31 Dec. 1987
D. A. Koss Mar. 1988 27 p
(Contract N00014-86-K-0381)
(AD-A193767) Avail: NTIS HC A03/MF A01 CSCL 11F

Progress is reviewed for a research program whose purpose

is to establish a broad-based understanding of the application and consequences of advanced processing techniques, especially as they influence the strength and fracture resistance of high performance structural alloys. While some of the research is specific to certain alloy systems, much of the program constitutes a fundamental study of the deformation and fracture of engineering alloys containing processing-induced defects. GRA

N88-29011# Virginia Univ., Charlottesville.
STRUCTURAL RELATIONSHIP BETWEEN ICOSAHEDRAL AND FRANK-KASPER PHASES OF Al-Li-Cu
W. Dmowski, T. Egami, Y. Shen, S. J. Poon, and G. J. Shiflet 1987 7 p
(Contract DAAL03-87-K-0057)
(AD-A193768; ARO-24122.1-MS) Avail: NTIS HC A02/MF A01 CSCL 11F

We report on an X-ray diffraction study of the structure of the icosahedral and Frank-Kasper phases of Al5-Li3-Cu. It is shown that the two phases have very similar local structure up to about 20 angstroms, while the long-range structure is quite distinct. A detailed analysis of the Frank-Kasper phase suggests that the reported atomic positions and site occupations of this compound are not accurate, and the local structure of this compound is actually closer to that of the quasicrystalline unit cells proposed for the icosahedral phase. The results are consistent with the decorated quasicrystalline lattice model. GRA

N88-29012*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD AND APPARATUS FOR NON-DESTRUCTIVE TESTING OF TEMPER EMBRITTLEMENT IN STEELS Patent Application
Sidney G. Allison, inventor (to NASA), Namkung Min, inventor (to NASA), William T. Yost, inventor (to NASA), and John H. Cantrell, inventor (to NASA) 23 Jun. 1988 24 p
(NASA-Case-LAR-13817-1; NAS 1.71:LAR-13817-1; US-Patent-Appl-SN-210486) Avail: NTIS HC A03/MF A01 CSCL 11F

A method and apparatus for testing steel components for temper embrittlement uses magneto-acoustic emission to nondestructively evaluate the component. Acoustic emission signals occur more frequently at higher levels in embrittled components. A pair of electromagnets are used to create magnetic induction in the test component. Magneto-acoustic emission signals may be generated by applying an ac current to the electromagnets. The acoustic emission signals are analyzed to provide a comparison between a component known to be unembrittled and a test component. Magnetic remanence is determined by applying a dc current to the electromagnets, then turning the magnets off and observing the residual magnetic induction. NASA

N88-29013# Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Desarrollo.
PHENOMENA OF THE IONIC TRANSPORT IN THE STRESS CORROSION OF METALS Ph.D. Thesis
S. M. Gravano Jul. 1986 408 p In SPANISH; ENGLISH summary Prepared in cooperation with Universidad Nacional de Cuyo, Mendoza (Argentina). Inst. Balseiro.
(DE88-702502; CNEA-NT-16/86; CNEA-PMTM/T-6) Avail: NTIS HC A18/MF A01

For the study of electrochemical conditions of propagation, a model which calculates the concentrations and potential profiles inside cracks or localized corrosion cavities, was developed. Considering transport by diffusion and migration it was applied to pure metals (Zn, Fe) in solutions where pitting occurs (NaCl or Na2SO4, with borate buffer), and also extended to systems where stress corrosion cracking is present, such as Cu and yellow brass in NaNO2. Physical bases of the constant intermediate elongation rate technique to predict stress corrosion cracking susceptibility was analyzed, studying by mathematical models: (1) dissolution current, that should be the result of superposition of repassivation transients on the fresh metal, exposed to corrosive medium by strain, with the same rate of that of a static specimen; (2) ohmic drop, that is some systems could be quite important and it must be considered in the overpotential evaluation; and (3) metallic ion concentration that, instead of what happens in a crack, never attains saturation in the analyzed cases. For repassivation transient according to the crack propagation models proposed by Scully and Ford it was found that, at the tip of the crack, it is unlikely that the same repassivation transients occur as in the constant intermediate elongation rate experiments. DOE

N88-29014# International Centre for Theoretical Physics, Trieste (Italy).
INFLUENCE OF LOCAL VOLUME FORCES ON SURFACE RELAXATION OF PURE METALS AND ALLOYS: APPLICATIONS TO Ni, Al, Ni3Al
E. J. Savino and D. Farkas Nov. 1987 31 p
(DE88-702718; IC-87/325) Avail: NTIS (US Sales Only) HC A03/MF A01

An analysis is presented of the relative influence of the interatomic potential, lattice structure and defect symmetry on the calculated and measured distortion for the free surfaces of alloys and pure metals. In particular, the effect of using local volume dependent interactions is studied, as opposed to simple pair interatomic forces. The dependence of the relaxation on the lattice structure is examined by comparing pure metals with ordered alloys. A Green's function method for surface relaxation is presented and used for the above analysis as well as for studying the influence of different surface symmetries. Examples based on computer simulation of Ni, Al and Ni3Al for some surface orientations are presented. DOE

N88-29015# Technische Univ., Hamburg (West Germany).
RELATION BETWEEN STRENGTH, CREEP AND RELAXATION BEHAVIOR IN Cu AND Al AT ROOM TEMPERATURE Ph.D. Thesis [ZUSAMMENHANG ZWISCHEN VERFESTIGUNGS-, KRIECH- UND RELAXATIONSVERHALTEN IN CU AND AL BEI RAUMTEMPERATUR]
Burkhard Nicklas 1987 126 p In GERMAN
(ETN-88-92982) Avail: NTIS HC A07/MF A01

Three types of tests are analyzed to study material behavior and to permit its prediction in various conditions of stress and strain. In tensile tests by constant expansion velocity, residual stress and elongation data are obtained. Stress relaxation is determined in relation to initial stress and initial elongation velocity, load cycle, and restored relaxation. An empirical description of relaxation data is given. Influence of creep stress and determination of transition creep is formulated. The various types of stresses, tensile with relaxation tests, creep with relaxation, and tensile with creep tests are compared. ESA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N88-29016# National Bureau of Standards, Gaithersburg, Md. Ceramics Div.
STRESS CORROSION OF CERAMIC MATERIALS Annual Report, 1 Oct. 1986 - 30 Sep. 1987
S. W. Freiman, G. S. White, T. R. Palamides, M. L. Balmer, and A. M. Wilson 10 Jan. 1988 78 p
(Contract N00014-87-F-0007)
(AD-A191979) Avail: NTIS HC A05/MF A01 CSCL 11B

Environmentally enhanced crack growth data was obtained for GaAs in a number of chemical environments. The effectiveness of particular environments was predicted on the basis of existing crack growth models. No environment was found to produce crack growth in silicon. Dielectric aging studies were conducted on capacitor ceramics. A correlation was shown between decreases in dielectric constant and reductions in indentation strength at small indentation loads. GRA

N88-29017# Southwest Research Inst., San Antonio, Tex. Fuels and Lubricants Research Facility.
HIGH HOT-HARDNESS GEAR LUBRICANT EVALUATIONS, PHASE 2 Interim Report, Oct. 1982 - Dec. 1987
Burl B. Baber Dec. 1987 34 p
(Contracts DAAK70-82-C-0001; DAAK70-85-C-0007; DA Proj. 1L7-62733-AH-20)
(AD-A192309; AD-E801594; BFLRF-242) Avail: NTIS HC A03/MF A01 CSCL 11H

A WADD gear machine was used to evaluate the gear load-carrying capacities of three high hot-hardness gear materials, CBS-600, EX-00053, and VASCO X-2, at 74 and 218 C (165 and 425 F). Five NATO lubricants and three lubricant mixtures were evaluated at the 218 C (425 F) test condition. An increase in the gear load-carrying capacities of all five lubricants and three lubricant mixtures evaluated was obtained with CBS-600 and VASCO X-2 gears when compared with their equivalent 74 C (165 F) data using AMS-6260 gears. The EX-00053 test gears showed increases in load-carrying capacities for four of the five lubricants and two of the three lubricant mixtures when compared with respective 74 C (165 F) data using AMS-6260 gears. GRA

N88-29018# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
THIN FILM-RESIDUAL STRESS ASSESSMENT
D. J. Chang, R. Muki, P. M. Adams, K. W. Paschen, and C. Tseng 12 Feb. 1988 81 p
(Contract F04701-85-C-0086)
(AD-A193205; TR-0086A(2935-12)-3; SD-TR-88-28) Avail: NTIS HC A05/MF A01 CSCL 11C

That residual stresses exist in thin film coated structures was know for decades. Their existence plays an important role in the ability of coated structures to withstand external loads which might arise from mechanical, thermal, electrical, and optical environments. Magnitudes of the residual stresses are influenced by many factors. These include mechanical properties of the films and substrates, mismatch of the thermal expansion between films and substrates, processing parameters such as deposition rate, film thickness, substrate temperature and chamber pressure during deposition and coating/substrate adhesion characteristics. A successful prediction of deformation of thin film coated structures; detailed understanding of the mechanical and thermophysical properties of the films and substrate materials. This report documents the results, findings, progress, and status of the residual stress assessment activities in the following categories: analytical, derivation of stress behavior in the film coated substrates; development of viable measuring techniques to determine the deformation of thin film coated structures; establishment of a testing methodology to quantify the coating material properties in thin film configurations; and identification of failure modes and failure mechanisms to provide information toward the establishment of failure criteria of thin film coated structures. Author

N88-29019# Massachusetts Univ., Amherst. Dept. of Chemistry.
THE RADIATION SENSITIVITY OF SELECT METAL CHELATE POLYMERS: MECHANISTIC CHANGES AT HIGHER ENERGIES
Ronald D. Archer, Christopher J. Hardiman, and Annabel Y. Lee 1 Oct. 1987 12 p
(Contract N00014-86-K-0345)
(AD-A193467; TR-11) Avail: NTIS HC A03/MF A01 CSCL 07E

Based on uranyl photochemistry in the visible and ultraviolet region, uranyl carboxylates are known to undergo CO2 evolution; however, with gamma radiation (cesium-137, 662 keV) a sizable number of uranyldicarboxylate polymers crosslink with high efficiency and without CO2 evolution. On the other hand several dicarboxylates with sulfur in the organic backbone exhibit very high scission efficiency. The G values in excess of normal organic resists is related to the heavy atom content of these metal coordination polymers. GRA

N88-29020# Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (West Germany).
WAVE AND FRACTURE PHENOMENA IN IMPACTED CERAMICS Periodic Report No. 1, Dec. 1987 - Feb. 1988
S. Winkler Feb. 1988 4 p
(Contract DAAJ45-88-C-0011)
(AD-A192946; U-5/88; R/D-5823-MS-01) Avail: NTIS HC A02/MF A01 CSCL 11B

An optical measuring technique in combination with high speed photography is provided to solve the problem of this contract, the investigation of wave and fracture phenomena in opaque ceramic materials. Surface disturbances caused by these mechanical events will deflect reflected light from its ordinary direction and thus give rise for shadow patterns which can be photographed. Specimens with the dimensions 100 mm by 10 mm shall be impacted on one of the smaller surfaces by a projectile in order to generate these events. In parallel to this work it has also been intended to prepare specimens of alumina, for it is believed that with this material results can be obtained easier than with boroncarbide. Author

N88-29021# Technische Hogeschool, Delft (Netherlands). Lab. voor Metaalkunde.
DEVELOPMENT OF CREEP FRACTURE MODELLING IN CERAMICS
C. C. E. vanderSijp Aug. 1986 67 p
(PB88-202825) Avail: NTIS HC A04/MF A01 CSCL 11B

Creep fracture at high temperature typically involves two sequential processes: crack nucleation and crack propagation. The latter is often associated with the coalescence of the crack with cavities in front of the crack tip. Both processes must be characterized comprehensively in order to establish a generalized description of the final failure. Since 1957 a wide range of models concerning creep fracture in ceramics have been developed. These will be presented in a more or less historical order. The applicability, however, for either single phase materials or materials containing an intergranular second phase will depend on the considered model. Author

N88-29022# Pennsylvania State Univ., University Park.
THE MECHANICAL BEHAVIOR OF SURFACE MODIFIED CERAMICS Progress Report
1988 5 p
(Contract DE-FG02-86ER-45252)
(DE88-010564; DOE/ER-45252/T2) Avail: NTIS HC A02/MF A01

Ceramics can be strengthened by compressive stresses on the surface. This can be done either thermally (tempering of glasses), chemically (ion exchange, doping) or physically (thermal expansion of surface and bulk). Vicker's indentation techniques were used to estimate the residual stresses on surfaces. Aluminosilicate glass samples were ion exchanged in molten KNO3 at a constant temperature for 2 min-25 h. The samples were then indented using a Vicker's diamond indentor. An attempt was also made to find a suitable infiltrant for surface modification of alumina with chromia. Solid state diffusion was examined. Samples were heated in powder beds containing Cr2O3 and various amounts of CrF3, 3.5 H2O (0,5,10,15,20) at 1500 C for various times. Electron microprobe analysis and scanning electron microscopy with X-ray dispersive analysis were used. Residual stresses in thermal barrier coatings were also investigated. Plasma-sprayed thermal barrier coatings (TBC's) applied to superalloy jet turbine blades increase oxidation resistance and allow higher operating temperatures. Due to the plasma-spray process, microstrains and small coherently diffracting regions are introduced into the TBC's. DOE

N88-29023# Japan Atomic Energy Research Inst., Tokyo. Dept. of Development.
OPTICAL EMISSION BEHAVIOR AND RADIATION RESISTANCE OF EPOXY RESINS
Shunichi Kawanishi, Akira Udagawa, and Miyuki Hagiwara Nov. 1987 24 p In JAPANESE; ENGLISH summary
(DE88-752629; JAERI-M-87-185) Avail: NTIS (US Sales Only) HC A03/MF A01

To make clear a mechanism of radiation resistance of epoxy resin systems, a role of energy trapping site induced in bisphenol A type epoxy resins cured with 4 kinds of aromatic amines (phi sub N) was studied in comparison with the case of aliphatic amine curing system through a measurement of optical emission. In the system of the epoxy resin cured with DETA, the optical emission from an excited state of bisphenol A unit of epoxy resin and a charge transfer complex was observed. On the other hand, the optical emission from phi sub N was observed in the aromatic amine curing system. Their excitation spectrum consists of peaks of absorption spectrum of BA and those of phi sub N, showing that the excited state of phi sub N is formed through the excitation of both BA and phi sub N. Therefore, the excited energy of BA transfers to the excited state of phi sub N. Emission intensity of phi sub N band was 20 approx. 100 times as large as that of BA. These results indicate that the radiation energy is effectively released as an optical emission from excited state of phi sub N in the epoxy resin when cured with aromatic amine. It can be concluded from the above results that aromatic amine hardeners contribute to enhancement of the radiation resistance of epoxy resin by acting as an energy transfer agent. DOE

N88-29024# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
SINTERABLE CERAMIC POWDERS FROM LASER-HEATED GASES Final Report, 1 Apr. 1982 - 31 May 1986
John S. Haggerty Feb. 1988 155 p
(Contract N00014-82-K-0350)
(AD-A194162; MIT-EL-88-001) Avail: NTIS HC A08/MF A01 CSCL 11B

Extremely high quality ceramic powders have been synthesized from SiH4, NH3, and CH4 reactant gasses that are heated by absorbing energy emitted from a CO2 laser. Resulting Si, Si3N4 and SiC powders have been characterized in terms of parameters which are important for densification processes. The powders are virtually ideal. The fully dispersible powders have mean diameters ranging from 0.1 to 0.3 micrometers with a standard deviation that is typically 25 to 45 percent. As synthesized powders are extremely high purity because the synthesis equipment is hermetic and cold-walled. The synthesis process has been modeled on a macro scale with respect to heat-transfer, fluid-flow and stability criteria. These results have permitted the process to be scaled safely to production rates up to 8 to 40 tons/year/nozzle. GRA

N88-29025# Metaalinstitut TNO, Apeldoorn (Netherlands).
CHARACTERIZATION OF LUBRICANTS IN TERMS OF TRANSITION DIAGRAM DATA Final Report, Sep. 1985 - Mar. 1988
J. W. Mens and A. W. deGee 31 Mar. 1988 58 p
(Contract DAJA45-85-C-0015; DA Proj. 1L1-61103-BH-57)
(AD-A194264; R/D-4481-AN-01) Avail: NTIS HC A04/MF A01 CSCL 11H

Characterization of lubricants, meant for application in counterformal contact situations (concentrated sliding contacts), is usually performed with standard tests, e.g., of the four-ball type. Results thus produced are of limited value, because of doubts regarding correlation with practical performance data. In this respect the IRG (International Research Group) Transition Diagram method, developed by the cooperative efforts of eight different laboratories, probably stands a better chance of success. As an example, five high-performance lubricants i.e., three mineral oils, i.e., Amoco 300, Citgo C-5 and REO 203 and two synthetic oils, i.e., Mobil Jet II and Royco 555, were characterized with this method. GRA

N88-29026# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
BLENDS OF CRYSTALLIZABLE POLYBUTADIENES Technical Report No. 4
M. Marx and R. E. Cohen 29 Apr. 1988 33 p
(Contract N00014-87-K-0517)
(AD-A194536) Avail: NTIS HC A03/MF A01 CSCL 07F

This report provides baseline data on two crystalline polybutadiene homopolymers (trans 1,4 PBD and syndiotactic 1,2 PBD) and on 50/50 weight percent homopolymer blends. Blends were prepared by a solution casting method discussed in the report. Results of molecular characterization and thermal analysis experiments are presented. GRA

N88-29027# Cornell Univ., Ithaca, N.Y. School of Chemical Engineering.
DISSOLUTION RATES OF POLYMERS AND COPOLYMERS BASED ON METHYL, ETHYL AND BUTYL METHACRYLATE Technical Report No. 8
Robert J. Groele and Ferdinand Rodriguez 16 May 1988 8 p
(Contract N00014-85-K-0474)
(AD-A194713) Avail: NTIS HC A02/MF A01 CSCL 07F

The rate of dissolution (DR) of thin (1 micrometer) films of various methacrylate polymers was measured using lasers interferometry. The polymers were all of high (Mn greater than 600,000) molecular weight and included homopolymers of methyl methacrylate, MMA, ethyl methacrylate, EMA, and n-butyl methacrylate, BMA, as well as copolymers of MMA with EMA and with BMA. Glass transition temperatures estimated by DSC ranged from 36 C (PBMA) to 115 C (PMMA). Films were applied to silicon wafers by conventional spinning and baking. The DRs in methyl isobutyl ketone at 30 C ranged from 0.042 micrometer (PMMA) to c. 150 micrometer/min (PBMA). Activation energy, Ea, in the limited span of 20 to 40 decreased as Tg decreased. In agreement with other workers, Ea for PMMA was 25 kcal/mol. However, the Ea dropped almost to half that value for PEMA and for BMA-rich copolymers. GRA

N88-29028# Arizona Univ., Tucson.
POLYMERIZATION OF AZAETHYLENES (IMINES) AND AZA-1,3-DIENES: POTENTIAL REACTIVE MONOMERS Final Report, 1 Mar. 1985 - 29 Feb. 1988
Henry K. Hall, Jr. 1 Apr. 1988 9 p
(Contract DAAG29-85-K-0068)
(AD-A194717; ARO-22109.6-CH) Avail: NTIS HC A02/MF A01 CSCL 07C

Several types of new imine monomers have been synthesized and their polymerizability has then been investigated in different conditions. The main classes of imines studied include 1-aza-1,3-butadienes with an electron donating or electron-accepting substituent on nitrogen, 2-aza-1,3-butadienes with a substituent in the 1-position, imines with three electron-accepting. Substituents, and imines with only one electron-accepting substituent. GRA

N88-29029# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Macromolecular Science.
HIERARCHICAL STRUCTURE IN POLYMERIC SOLIDS AND ITS INFLUENCE ON PROPERTIES Final Report, 1 Oct. 1984 - 31 Dec. 1987
Eric Baer 15 Apr. 1988 7 p
(Contract DAAG29-84-K-0155)
(AD-A194720; ARO-21878.10-MS) Avail: NTIS HC A02/MF A01 CSCL 06D

The intervertebral disc is a biological composite whose hierarchical structure is designed to function in a wide range of physiological loading modes. The intervertebral disc is located in the spinal column between the bony vertebral bodies. Their function is to absorb shock and to permit motion between spinal segments. The disc is composed of two parts: a gelatinous nucleus pulposis containing a network of collagen type II fibers, hydrophillic protoglycan molecules, and up to 88 percent water and the concentric lamellar walls of the annulus fibrosis which is made up primarily of large fibers of collagen type I. The disc is anchored to the vertebral bodies above and below it by cartilage endplates. Optical microscope techniques are used to characterize the hierarchical structure of the collagenous components of the intervertebral disc. These findings are employed in explaining the mechanical response of the disc in compression. GRA

N88-29030# Akron Univ., Ohio. Inst. of Polymer Science.
ELASTIC BEHAVIOR OF A RUBBER LAYER BONDED BETWEEN TWO RIGID SPHERES Technical Report No. 15
A. N. Gent and Y.-C. Hwang May 1988 31 p
(Contract N00014-85-K-0222)
(AD-A193698) Avail: NTIS HC A03/MF A01 CSCL 11J

Finite element methods (FEM) have been employed to calculate the stresses set up in a thin rubber layer, bonded between two rigid spheres, when small tensile or compressive deflections are imposed. Values of stiffness have been calculated for various spacings of the spheres, i.e., for various thicknesses of the rubber layer. They are in good agreement with earlier experimental measurements of compression stiffness and with predictions of an approximate theoretical treatment. However, they are strongly affected by small departures of the rubber layer from complete incompressibility. The highest dilatant stress (in tension) is found to be set up on the central axis, near the bonded surfaces, where internal failure has been observed to occur in similar bonded layers. For moderately thick layers, the axial tensile stress in the center of the layer is substantially higher than the lateral stresses. This feature suggests that the initiation of failure in this location may not obey the same criterion as for an isotropic stress field, and that a crack, once formed here, will propagate as a tear across the axis of symmetry. GRA

N88-29031# Northwestern Univ., Evanston, Ill. Materials Research Center.
POLYMERIC ELECTROLYTES
P. M. Blonsky, S. Clancy, L. C. Hardy, C. S. Harris, and R. Spindler 1987 23 p
(Contract N00014-80-C-0532)
(AD-A193766; TR-019) Avail: NTIS HC A03/MF A01 CSCL 07D

Research on solvent-free polymer electrolytes is currently very active, because of their potential applications in high energy density batteries, specific ion sensors, electrochromic displays, and other electrochemical devices. Pure ionic and mixed ionic-electronic conducting polymer-salt complexes are discussed. Vibrational spectroscopy, X-ray diffraction and EXAFS spectroscopy studies have provided structural information on PEO-salt complexes. For the sodium and lithium complexes, the cations are coordinated to the polyether oxygen atoms, and these cations reside within the helical tunnel of the PEO which is in a (T2GT2G) conformation. This proposed structure is comparable to the complexes formed between alkali metal salts and crown ethers. The formation of PEO-salt complexes can be understood in terms of a balance between the lattice energy of the salt and the coordination energy of the cation by the polymer. In general, salts with large mononegative anions favor complex formation because of their low lattice energies. GRA

N88-29032# Rensselaer Polytechnic Inst., Troy, N.Y.
METAL HALIDE OPTICAL GLASSES Final Technical Report, Dec. 1982 - Jun. 1985
C. T. Moynihan and J. Schroeder Jan. 1988 183 p
(Contract F19628-83-C-0016)
(AD-A193794; RADC-TR-87-279) Avail: NTIS HC A09/MF A01 CSCL 11B

The results of a number of investigations of ZrF4-based and other heavy metal fluoride glasses are presented. The purpose of these investigations has been primarily to explicate properties and behavior of these glasses relevant to their use as optical transmission media. The temperature dependence of viscosity could be described via the four parameter Cohen-Grest equation, allowing estimation of viscosities in temperature ranges where measurement of viscosity was not possible due to rapid crystallization. Characterization of the temperature dependence of Viscosity in the Region of the glass transition temperature Tg was done for a large number of HMF glasses using a differential scanning calorimetry (DSC) technique. GRA

N88-29033# Tufts Univ., Medford, Mass. Lab. for Materials and Interfaces.
TRANSPORT OF ORGANIC VAPORS IN MULTIPHASE POLYMER SYSTEM Final Technical Report, 1 Oct. 1983 - 31 Dec. 1987
Nak-Ho Sung and Jerry H. Meldon Feb. 1988 11 p
(Contract DAAG29-83-K-0137)
(AD-A194097; ARO-20485.7-CH) Avail: NTIS HC A03/MF A01 CSCL 11J

Sorption of organic vapors in glassy-rubbery heterophase polymers is investigated using polystyrene (PS)/Polybutadiene (PB) blends and block copolymers. Experimental data on hexane vapor sorption in phase segregated blends (mixture of dispersed PS microspheres in PB matrix) and block copolymers exhibit non-Fickian characteristics that previous workers with PS/PB copolymers attributed to a diffused interphase. These data, plus results from a model of sorption in heterogeneous media containing a slowly permeable dispersed phase, indicate that the mere presence of two phases with different diffusion time constants is a sufficient condition for apparently non-Fickian behavior. A mold of vapor transport in glassy polymer is presented and employed in conjunction with sorption experiments with PS microspheres in order to determine pertinent diffusion and relaxation constants. GRA

N88-29034# Dayton Univ., Ohio. Research Inst.
A STUDY OF THE FLOATING ROLLER PEEL TEST FOR ADHESIVES Interim Report, 3 Jan. 1986 - 9 Jun. 1987
R. D. Kemp, Robert A. Brockman, and Gregory J. Stenger Oct. 1987 66 p
(Contract F33615-85-C-5094)
(AD-A194114; UDR-TR-87-82; AFWAL-TR-87-4082) Avail: NTIS HC A04/MF A01 CSCL 11A

Peel testing of adhesives has not been extensively evaluated using analytical methods. Current test methods cannot discriminate between the work required to deform the adherend and the work needed to fail the adhesive. In some cases, the work required to bend the adherend is much greater than that required for adhesive failure. Further complications arise from inconsistent failure modes. Each of these circumstances can result in invalid or meaningless data. The objective of this investigation was to evaluate and improve the Floating Roller Peel Test (ASTM D3167) to enhance the accuracy and significance of the test results and to develop an analytical technique for calculating the work required to deform the adherend. GRA

N88-29035# International Centre for Theoretical Physics, Trieste (Italy).
SOLITON AND POLARON DYNAMICS IN CONDUCTING POLYMERS
Zhaobin Su and Lu Yu May 1987 20 p
(DE88-702539; IC-87/104) Avail: NTIS (US Sales Only) HC A03/MF A01

Solitons and polarons in conducting polymers are strongly coupled electron-lattice excitations. The lattice relaxation theory generalized by us to include the self-consistency of multi-electron states with lattice symmetry-breaking is summarized. The discrete symmetries and corresponding selection rules for both radiative and nonradiative processes are discussed. Theoretically calculated probability of nonradiative decay of an electron-hole pair into a solitron pair and that of electron (hole) into polaron as well as the probability of soliton pair photogeneration is compared with results of numerical and laboratory experiments. The resonance Raman scattering data of cis-polyacetylene are interpreted in terms of a bipolaron model. The parameters involved are determined directly from experimental data. Other applications of lattice relaxation theory to conducting polymers are briefly mentioned. DOE

N88-29036# Technische Hogeschool, Delft (Netherlands).
DRY ADHESIVE FRICTION OF ELASTOMERS: A STUDY OF THE FUNDAMENTAL MECHANICAL ASPECTS Ph.D. Thesis

Arvin Ramachandra Savkoor 1987 328 p
(ETN-88-92903) Avail: NTIS HC A15/MF A01

Contact mechanisms of adhesion; tangential interaction of elastic bodies; surface topology effects in adhesion and friction; the theory of isothermal friction of elastomers; an experimental study of isothermal friction of elastomers; and the influence of the physico-chemical properties of the counterface are discussed. ESA

N88-29037# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
THE SOL-GEL SYNTHESIS OF CERAMICS
C. Pierre and D. R. Uhlmann (Arizona Univ., Tucson.) 1988 7 p
(SNIAS-881-430-114; ETN-88-92862) Avail: NTIS HC A02/MF A01

The main stages of the sol-gel process and the chemistry of the processes are described. First gelation processing is outlined. ESA

N88-29038# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
Al2O3-TiO2 AND Al2TiO5 CERAMIC MATERIALS
T. Woignier, P. Lespade, J. Phalippou, and R. Rogier (Montpellier Univ., France) 1988 16 p
(SNIAS-881-430-122; ETN-88-92869) Avail: NTIS HC A03/MF A01

Sol-gel processing of dense ceramic bodies from a cohydrolysis reaction of two alkoxide compounds is described. When Al2TiO5 compound shows a low expansion coefficient its mechanical properties are very low. The microcracking of the sample due to anisotropy of expansion accounts for the two effects which seem to be linked. The potential advantages of the sol-gel process are lost with the crystallization phenomena. Crystallization leads to TiO2 and Al2O3 which must be then reacted at high temperature to produce Al2TiO5. The necessary time to form Al2TiO5 and to sinter may be reduced by using a hot pressing procedure. Compact constituted by smaller grain are obtained. In this case, the materiel shows better mechanical properties but its expansion coefficient is higher. It is noted that mechanical properties and stabilization of Al2TiO5 can be increased by the addition of other oxides. However the increase in mechanical properties enhances the expansion coefficient and lowers thermal shock resistance. ESA

N88-29039# Illinois Univ., Chicago. Dept. of Chemistry.
POLYAZIDOESTERS AS ENERGETIC POLYMERS AND COPOLYMER COMPONENTS WITH FLUORO DERIVATIVES
Final Report, 1 Nov. 1984 - 31 Nov. 1987
Robert M. Moriarty 13 Apr. 1988 18 p
(Grant AF-AFOSR-0024-85)
(AD-A194236; AFOSR-88-0465TR) Avail: NTIS HC A03/MF A01

The 4,4'-Diazidodiphenylpolyester was synthesized by ozonolysis of 4,4'-bis (acetylamino) benzoin. By an alalogous series of steps a momoazido analog was synthesized. A substituted cubyl polyester was synthesized via a multistep synthesis. A novel and versatile method was discovered for the synthesis of vicinal diazides. Structural and mechanistic implications derived from this work are discussed. GRA

N88-29040* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BORON-CONTAINING ORGANOSILANE POLYMERS AND CERAMIC MATERIALS THEREOF Patent
Salvatore R. Riccitiello, inventor (to NASA), Ming-Ta S. Hsu, inventor (to NASA), and Timothy S. Chen, inventor (to NASA) (HC Chem Research and Service, San Jose, Calif.) 30 Aug. 1988 10 p Filed 30 Jul. 1986 Supersedes N87-10205 (25 - 01, p 0035)
(NASA-Case-ARC-11649-1-SB; US-Patent-4,767,728; US-Patent-Appl-SN-890577; US-Patent-Class-501-91; US-Patent-Class-501-88; US-Patent-Class-501-92; US-Patent-Class-501-93; US-Patent-Class-528-4; US-Patent-Class-528-10; US-Patent-Class-528-30) Avail: US Patent and Trademark Office CSCL 11C

The present invention relates to organic silicon-boron polymers which upon pyrolysis produce high-temperature ceramic materials. More particularly, it relates to the polyorganoborosilanes containing -Si-B- bonds which generate high-temperature ceramic materials (e.g., SiC, SiB4, B4C) upon thermal degradation. The process for preparing these organic silicon-boron polymer precursors are also part of the invention.
Official Gazette of the U.S. Patent and Trademark Office

N88-29041*# National Aeronautics and Space Administration, Washington, D.C.
REACTION-THEORETICAL ASPECTS OF THE THERMAL BEHAVIOR OF LUBRICATING OILS AND WORKING FLUIDS
K. W. Schulze Aug. 1988 23 p Transl. into ENGLISH from Schmierungstechnik (Fed. Republic of Germany), v. 17, no. 10, 1986 p 308-311 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20304; NAS 1.77:20304) Avail: NTIS HC A03/MF A01 CSCL 11C

A portion of a review with 19 references of the principles and kinetic aspects of the thermal stability of lubricating oil and working fluids is presented. The thermal stabilization of various organic compounds in gaseous and liquid phases is examined, especially with regard to structure. Author

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-29042# Southwest Research Inst., San Antonio, Tex. Oelvoir Fuels and Lubricants Research Facility.
DEVELOPMENT OF A TEST METHOD TO DETERMINE POTENTIAL PEROXIDE CONTENT IN TURBINE FUELS. PART 2 Interim Report, Sep. 1985 - May 1987
G. E. Fodor, D. W. Naegeli, K. B. Kohl, and J. P. Cuellar, Jr. Jun. 1987 32 p
(Contracts N00014-85-C02520; DAAK70-85-C-0007; DAAK70-87-C-0043)
(AD-A192244; BFLRF-243-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 21D

Through the generally accepted 43 C and 65 C bottle storage method of accelerated aging, the relative ratings of six selected fuels' oxidative tendencies were established. In the 43 C test, storage for about 12 weeks produces results that are comparable to a full year's storage under ambient conditions. To develop a practical test method for the prediction of peroxide potential of fuels, experimental conditions were sought so that the oxidative tendencies of fuels could be assessed within a reasonable time. Accordingly, a matrix of experiments was designed to allow selection of reaction conditionally, the results of experiments should allow the development of global reaction kinetics to aid the determination of fuel peroxidation potential and to shed light on the reaction mechanism. The oxidations were carried out in a stirred pressurized reactor at 60, 80, 100, and 120 C, under oxygen pressures of 240, 790, or 1140 kPa (abs) for periods of up to 70 hours. GRA

N88-29043# Sandia National Labs., Albuquerque, N. Mex.
THE DESIGN OF METHANE ACTIVATION CATALYSTS
F. V. Stohl, J. A. Shelnutt, and B. Granoff 1988 11 p Presented at the 9th International Catalysis Congress, Calgary, Alberta, 26 Jun. 1988
(Contract DE-AC04-76DP-00789)

(DE88-002265; SAND-87-1165C; CONF-880602-1) Avail: NTIS HC A02/MF A01

The goal of Sandia's methane activation program is to use computer-aided-design (CAD) techniques to guide the synthesis of catalysts for the direct conversion of methane. Several enzymes, such as cytochrome P sub 450 and methane monooxygenase, catalyze the oxidation of alkanes to alcohols at low temperatures and pressures. An attempt is made to design catalysts that mimic these enzymes. CAD studies on porphyrins, which are the active sites in many enzymes, are being combined with: (1) structural characterization of naturally occurring catalysts; (2) the development of activity and selectivity tests; and (3) the synthesis and characterization of designed catalysts. Results of CAD studies on enzymes that carry out alkane activation or perform C sub 1 chemistry and on unique synthetic porphyrins have shown that the synthetic porphyrins can have site configurations analogous to these enzymes. The CAD work also uses molecular-energy minimization and dynamics calculations to evaluate methane interactions with the synthetic porphyrins. Activity tests have been set up for cyclohexane, hexane and butane with additional tests being developed for methane and ethane. Synthesis of designed porphyrins is currently under way. DOE

N88-29044*# Roberts Research Lab., Torrance, Calif.
DEVELOPMENT AND VERIFICATION OF NASA STANDARD INITIATOR-2 (NSI-2) Final Report
Linda Corbin-Roberts 15 Jun. 1988 51 p
(Contract NAS9-17249)
(NASA-CR-172069; NAS 1.26:172069) Avail: NTIS HC A04/MF A01 CSCL 19A

The results of verification testing under NASA Contract NAS9-17249 are summarized in this Final Report. An Appendix is published separately. The report contains a brief discussion of design elements, test results, and a discussion of the latter. The contract was awarded for development and demonstration of design modifications to the NASA Standard Initiator-1 (NSI-1), resulting in the development of NSI-2. The intent of the project was to develop and prove the following design features: (1) Protection from premature initiation due to electrostatic potential by means other than a spark gap; (2) Development of an integral insulated charge cup for use with a zirconium/potassium perchlorate type mixture; (3) Improved cost and reliability figures by the use of a deposited ridge; and (4) Elimination of dudding as a result of the pyrotechnic shock effect, the movement of the primer composition away from the bridge circuit. F.M.R.

N88-29045*# Roberts Research Lab., Torrance, Calif.
[DEVELOPMENT AND VERIFICATION OF NASA STANDARD INITIATOR-2 (NSI-2): APPENDIX] Final Report
Jun. 1988 25 p
(Contract NAS9-17249)
(NASA-CR-172070; NAS 1.26:172070) Avail: NTIS HC A03/MF A01 CSCL 19A

This is the Appendix to the Final Report on the results of verification testing on NASA Contract NAS9-17249. The test results are presented graphically in the Appendix. The Final Report is a brief discussion of design elements, test results, and a discussion of the latter. The contract was awarded for development and demonstration of design modifications to the NASA Standard Initiator-1 (NSI-1), resulting in the development of NSI-2. The intent of the project was to develop and prove the following design features: (1) Protection from premature detonation due to electrostatic potential by means other than a spark gap; (2) Development of an integral insulated charge cup for use with a zirconium/potassium perchlorate type mixture; (3) Improved cost and reliability figures by the use of a deposited bridge; and (4) Elimination of dudding as a result of the pyrotechnic shock effect, the movement of the primer composition away from the bridge circuit. F.M.R.

N88-29046# Sandia National Labs., Albuquerque, N. Mex.
SEMICONDUCTOR BRIDGE (SCB) IGNITER STUDIES. 1: COMPARISON OF SCB AND HOT-WIRE PYROTECHNIC ACTUATORS
R. W. Bickes, Jr., S. L. Schlobohm, and D. W. Ewick 1988 12 p Presented at the 13th International Pyrotechnics Seminar, Grand Junction, Colo., 11 Jul. 1988 Prepared in cooperation with Monsanto Research Corp., Miamisburg, Ohio
(Contract DE-AC04-76DP-00789)
(DE88-008802; SAND-87-3095C1; CONF-880750-3) Avail: NTIS HC A03/MF A01

Sandia National Laboratories has developed a means for igniting pyrotechnics, propellants and primary or secondary explosives using a semiconductor bridge (SCB) instead of the small metal bridgewires, called hot wires, conventionally used for explosive components. The SCB is a heavily n-doped silicon film, typically 100 microns long by 380 microns wide by 2 microns thick, which when driven with a short (20 microsec), low-energy current pulse (less than 3 mJ), generates a hot plasma that ignites the explosives. We report in this paper a study of pyrotechnic actuators built with SCB igniters in which we obtained the Langlie All-Fire, Langlie No-Fire and Electrostatic Discharge (ESD) characteristics. Two SCB designs were tested. The first (designated as a type 3-2) was the rectangularly shaped bridge described above. The second (designated as a type 15) included a modification of the rectangular bridge consisting of a narrow waist region. We compare our data for these prototype SCB components with the same actuators built with conventional hot-wire igniters. The results obtained demonstrated the main characteristics of SCB devices: (1) the SCB actuators functioned at one-tenth the input energy of the hot-wire actuators, (2) had higher no-fire currents than the hot-wire devices, (3) passed ESD tests, and (4) functioned in a few tens of microseconds versus the millisecond response of the hot-wire components. DOE

N88-29047# Chemical Dynamics Corp., Upper Marlboro, Md.
THEORETICAL INVESTIGATIONS OF NITROCUBANE DECOMPOSITION
Bruce C. Garrett 1987 3 p
(Contract N00014-87-C-0746)
(AD-A194556) Avail: NTIS HC A02/MF A01 CSCL 21I

The development of propulsion systems for the strategic defense initiative requires propellants which are highly energetic yet stable. An understanding of the factors controlling the stabilities of propellants requires knowledge of the detailed microscopic decomposition pathways and their relative rates. Experimental investigations can be limited by the inability to study individual elementary reaction steps, and the inability to attain the temperatures and pressures experienced in a detonation. Theoretical studies are a complementary tool to experiments and provide insight into the dynamics of the elementary reactions as well as crucial kinetic data. The theoretical calculation of the chemical reaction rate is a two step process: first, the interaction energies between the atoms is obtained from an electronic structure calculation, followed by a dynamical calculation of the rate. Currently, these methods can be routinely applied to provide accurate kinetic data only for relatively small systems. The goal of the present research is to extend and validate these methods for the treatment of much larger molecules such as those found in the decomposition of nitro derivatives of cubanes. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology*.

N88-29048*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD OF DISPENSING REAGENT CHEMICALS IN SPACE Patent Application
Patrick G. Barber, inventor (to NASA) (Longwood Coll., Farmville,

Va.), James H. Coleman, inventor (to NASA), and William J. Debnam, inventor (to NASA) 23 Jun. 1988 13 p
(NASA-Case-LAR-13607-1-CU; NAS 1.71:LAR-13607-1-CU; US-Patent-Appl-SN-210445) Avail: NTIS HC A03/MF A01 CSCL 22A

A procedure for the slow, controlled release of a reagent chemical in a reaction solution is described. A liquid gel is prepared, and a reagent chemical is added while the gel is still liquid. The gel solution thereby formed is poured into a storage container, and allowed to set. A desired amount of gel-tube is dispensed into a reaction solution, and the reagent chemical slowly diffuses out of the gel-tube. NASA

N88-29361*# Alabama Univ., Huntsville.
OPTIMIZATION OF LOW GRAVITY MATERIALS PROCESSING EXPERIMENTS USING EXPERT SYSTEMS
Gary L. Workman and Amar Choudry *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 93-103 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22A

N88-29376*# Vanderbilt Univ., Nashville, Tenn.
A GENERIC EXPERT SYSTEM FOR MATERIALS PROCESSING IN SPACE
Kristinn Andersen, George E. Cook, and Alvin M. Strauss *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 227-236 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22A

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-29049# Helsinki Univ. Technology, Otaniemi (Finland).
MODEL TEST OF AIR-EXCHANGE EFFICIENCY
K. Krzysztof Apr. 1987 49 p
(DE88-752862; TKK-KO/LVI-B14) Avail: NTIS (US Sales Only) HC A03/MF A01

The report provides a summary of the laboratory tests. The mixing air flow pattern was studied. Three air flows were tested in a laboratory test room. The tracer gas technique and decay method were used. The indices of air exchange efficiency were calculated, namely: overall air exchange efficiency and room air mean age for the whole room; local ventilation indices and local mean ages of air at 10 points distributed throughout the room. Experiments were carried out in both isothermal and nonisothermal conditions. Based on the theory of similarity requirements a reduced-scale model, geometrically similar to the laboratory test room, was built. Air flows and temperature differences were calculated for the model tests in order to make them comparable with the full scale and the tests were repeated. Air served in the model tests as a working fluid (Pr-const.) and refrigerant 12 was used as the tracer gas both in the full scale and model tests. The objective of the study was to determine the relation between the air exchange efficiency indices obtained in the model and on the full scale. The overall air exchange efficiencies and local ventilation indices were equal in the model and full scale when there was no short-circuiting. A new formula for calculating local mean ages on a full scale, based on a reduced scale model experiment, was developed. DOE

N88-29050*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SURFACE TENSION CONFINED LIQUID CRYOGEN COOLER (STCLCC) Patent Application
Stephen H. Castles, inventor (to NASA) and Michael E. Schein, inventor (to NASA) 13 Jun. 1988 9 p
(NASA-Case-GSC-13112-1; NAS 1.71:GSC-13112-1; US-Patent-Appl-SN-205771) Avail: NTIS HC A02/MF A01 CSCL 13B

A cryogenic cooler is provided for use in craft such as launch, orbital, and space vehicles subject to substantial vibration, changes in orientation, and weightlessness. The cooler contains a small pore, large free volume, low density material to restrain a cryogen through surface tension effects during launch and zero-g operations and maintains instrumentation within the temperature range of 10 to 140 K. The cooler operation is completely passive, with no inherent vibration or power requirements. NASA

N88-29051*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD FOR MAINTAINING PRECISE SUCTION STRIP POROSITIES Patent Application
Frank H. Gallimore, inventor (to NASA) (McDonnell-Douglas Corp., Huntington Beach, Calif.) 22 Jul. 1988 21 p
(NASA-Case-LAR-13638-1; NAS 1.71:LAR-13638-1; US-Patent-Appl-SN-223124) Avail: NTIS HC A03/MF A01 CSCL 13B

This invention relates to a masking method generally and, more particularly to a method of masking perforated titanium sheets having laminar control suction strips. As illustrated in the drawings, a nonaerodynamic surface of a perforated sheet has alternating suction strip areas and bonding land areas. Suction strip tapes overlie the bonding land areas during application of a masking material to an upper surface of the suction strip tapes. Prior to bonding the perforated sheet to a composite structure, the bonding land tapes are removed. The entire opposite aerodynamic surface is masked with tape before bonding. This invention provides a precise control of suction strip porosities by ensuring that no chemicals penetrate the suction strip areas during bonding. NASA

N88-29052* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
METHOD OF FORMING DYNAMIC MEMBRANE ON STAINLESS STEEL SUPPORT Patent
Joseph L. Gaddis, inventor (to NASA) and Craig A. Brandon, inventor (to NASA) (Clemson Univ., S.C.) 9 Aug. 1988 5 p Continuation of US-Patent-Appl-SN-755960, filed 17 Jul. 1985, abandoned, which is a continuation of US-Patent-Appl-SN-119334, filed 7 Feb. 1980, abandoned
(NASA-Case-MSC-18172-3; US-Patent-4,762,619; US-Patent-Appl-SN-898449; US-Patent-Class-210-639; US-Patent-Class-210-653; US-Patent-Class-210-500.25; US-Patent-Class-210-500.35; US-Patent-Class-427-245; US-Patent-Appl-SN-755960; US-Patent-Appl-SN-119334) Avail: US Patent and Trademark Office CSCL 13H

A suitable member formed from sintered, powdered, stainless steel is contacted with a nitrate solution of a soluble alkali metal nitrate and a metal such as zirconium in a pH range and for a time sufficient to effect the formation of a membrane of zirconium oxide preferably including an organic polymeric material such as polyacrylic acid.
Official Gazette of the U.S. Patent and Trademark Office

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-29053# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
OPEN BOSONIC STRING IN BACKGROUND ELECTROMAGNETIC FIELD
V. V. Nesterenko 1987 27 p
(DE88-702140; JINR-E-2-87-420) Avail: NTIS (US Sales Only) HC A03/MF A01

The classical and quantum dynamics of an open string propagating in the D-dimensional space-time in the presence of a background electromagnetic field is investigated. An important point in this consideration is the use of the generalized light-like gauge. There are considered the strings of two types; the neutral strings with charges at their ends obeying the condition q(sub 1) + q(sub 2) = 0 and the charged strings having a net charge q(sub 1) + q (sub 2) not = 0. The consistency of theory demands that the background electric field does not exceed its critical value. The distance between the mass levels of the neutral open string decreases (1 - e squared) times in comparison with the free string, where e is the dimensionless strength of the electric field. The magnetic field does not affect this distance. It is shown that at a classical level the squared mass of the neutral open string has a tachyonic contribution due to the motion of the string as a whole in transverse directions. The tachyonic term disappears if one considers, instead of M(sup 2), the string energy in a special reference frame where the projection of the total canonical momentum of the string onto the electric field vanishes. The contributions due to zero point fluctuations to the energy spectrum of the neutral string and to the Virasoro operators in the theory of charged string are found. DOE

N88-29054 Michigan Univ., Ann Arbor.
CODING FOR METEOR-BURST COMMUNICATIONS CHANNEL AND SIDE INFORMATION FOR CHANNELS WITH BLOCK-INTERFERENCE Ph.D. Thesis
Abdolrahman Khalid AlJabri 1987 124 p
Avail: Univ. Microfilms Order No. DA8801267

Two problems were investigated. The first problem is concerned with coding for meteor-burst communications channel; a channel characterized by its availability in bursts, fluctuation, but generally exponentially decaying gain within the majority of the bursts. This decay causes the errors to cluster at the end of the bursts. For this channel, two transmission schemes that exploit the exponential decay of the channel gain are designed to combat the clustering of errors at the end of the bursts. The performance measures used are the throughput in bits per second and the probability of completing the message in a given time. Further improvements are achieved by using the available feed back in an Automatic-Repeat-Request scheme. The second problem is an information theoretic study of the effects of side information on the capacity of channels with block-interference. The block-interference channel model can be used to represent many practical applications such as the slow frequency-hopped spread-spectrum communications, Random Access Memory (RAM), and many other situations. The capacity of a more general class of channels with block-interference is obtained in the presence and absence of side information at the transmitter, at the receiver, or at both. It is also shown that, in general, feedback from the receiver to the transmitter increases the capacity of the block-interference channel. Dissert. Abstr.

N88-29055# Prometheus, Inc., Middletown, R.I.
POLYNOMIALS WITH RESTRICTED COEFFICIENTS AND THEIR APPLICATIONS Final Report, 6 Mar. - 30 Sep. 1987
James S. Byrnes, Donald J. Newman, and Martin Goldstein 1987 145 p
(Contract F49620-87-C-0048)
(AD-A192589; AFOSR-88-0092TR) Avail: NTIS HC A07/MF A01 CSCL 20N

Certain design restrictions growing out of antenna theory yield a beautiful class of complex variables problems. Our work was devoted to formulating these problems in mathematical terms, solving some of them, and beginning work on the others. One important result achieved was the development of a new method of estimating Gaussian-type exponential sums. Improvements of our previous results in null steering and notch filtering were also attained. Other findings were obtained in the areas of: the robustness of polynomials with unimodular coefficients; the effect of errors in such standard and crucial approximations as the far-field, Fresnel, and Doppler compensation; the effect of errors in the noise covariance matrix; and the Parabolic Equation Method in underwater acoustics. GRA

N88-29056# Academy of Sciences of the Ukrainian SSR, Kharkov.
QUALITATIVE CHARACTERISTICS OF OPEN WAVEGUIDE RESONATOR SPECTRA
L. A. Rud, Yu. K. Sirenko, V. P. Shestopalov, and N. P. Yashina 1986 43 p In RUSSIAN; ENGLISH summary
(DE88-702387; INIS-SU-26) Avail: NTIS (US Sales Only) HC A03/MF A01

Analysis of elements (inhomogeneities) of the SHF channels is due to the solution of complex problems of mathematical physics. The paper deals with the results characterizing qualitatively the spectrum of open waveguide resonators. The features of analytical prolongation of diffraction problem resolvents into range of complex values of a frequency parameter have been studied as well as their distribution on the corresponding Riemann surface. The ranges in which the points of a spectrum can be involved are localized roughly, and the theorem of their existance has been proved. A basis for a numerical analysis of spectra and studying of resonance excitation processes both in the stationary (diffraction) and nonstationary regimes has been got. DOE

N88-29057# Oak Ridge National Lab., Tenn.
HIGH DEFINITION TELEVISION: EVALUATION FOR REMOTE TASK PERFORMANCE
J. V. Draper, S. J. Handel, and J. N. Herndon 1988 14 p Presented at the International Symposium on Teleoperation and Control, Bristol, England, 12 Jul. 1988
(Contract DE-AC05-84OR-21400)
(DE88-011573; CONF-880752-3) Avail: NTIS HC A03/MF A01

High definition television (HDTV) transmits a video image with more than twice the number of horizontal scan lines that standard resolution television provides (1125 for HDTV to 525 for standard resolution television), with impressive picture quality improvement. These experimental activities are part of a joint collaboration between the U.S. Department of Energy (USDOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan in the field of the Nuclear Fuel Cycle: Reprocessing Technology. Objects in the HDTV picture have more sharply defined edges, better contrast, and more accurate shading and color pattern reproduction. Because television is a key component for teleoperator performance, picture quality improvement could improve speed and accuracy. This paper describes three experiments which evaluated the impact of HDTV on remote task performance. HDTV was compared to standard resolution, monochromatic television and standard resolution, stereoscopic, monochromatic television. Tasks included judgement of depth in a televised scene, visual inspection, and a remote maintenance task. The experiments show that HDTV can improve performance. HDTV is superior to monoscopic, monochromatic, standard resolution television and to stereoscopic television for remote inspection tasks; it is less proficient than stereo television for distance matching. HDTV leads to lower error rate during tasks but does not reduce time required to complete tasks. DOE

N88-29058# National Aeronautical Establishment, Ottawa (Ontario).
AN OVERVIEW OF TECHNOLOGY FOR SPOKEN INTERACTION WITH MACHINES
M. J. Hunt Feb. 1988 38 p
(AD-A194153; NAE-AN-50; NRC-28714) Avail: NTIS HC A03/MF A01 CSCL 25D

This report provides a non-mathematical introduction to speech input and output technology. It is divided into three parts. The first presents necessary background information on speech: on its nature, its production and perception, and on methods of analysis and coding used in speech I/O. A central message is that our subjective impression of speech is misleading and causes us to underestimate the complexity of speech communication. The second part is concerned with speech output and discusses the trade-offs that must be made between the quality and flexibility of

the speech generated and the complexity and storage requirements of the speech output system. The final - and longest - part of the report deals with speech recognition. Arguments are presented in favor of statistical rather than rule-based approaches to speech recognition. The categories of recognizer currently available and the algorithms they use are briefly described, with the general conclusion that the performance obtained depends critically on the training process: on the type and quantity of the training material and on the amount of information derived from it. Three more detailed sections cover spectral representations and distance measures, the particular set of representations classed as auditory models, and techniques for handling noise and distortions. The last section discusses the difficulties of specifying recognizer performance, and recommends that all performance measurements should be treated with circumspection. GRA

N88-29059# Sigma Research, Inc., Redmond, Wash.
SIGNAL PROCESSING SOFTWARE FOR GROUND PENETRATING RADAR, USER'S MANUAL Final Report, Aug. 1985 - Sep. 1987
Ronnie Liem and Thomas J. Davis Mar. 1988 239 p
(Contract N62474-85-C-4953)
(AD-A194286; NCEL-CR-88.010) Avail: NTIS HC A11/MF A01 CSCL 17I

This is the user's manual for the signal processing software for reducing ground penetrating radar (GPR) data. The manual provides background information and instructions for operating the computer program. The developed program is based on the synthetic aperture focusing technique. Input data to the program consists of digitized sequential GPR scans from a linear survey. The format for the input data is specified in Appendix C. The output of the program are two-dimensional plots of the ground profile showing the stations and depth of the objects identified by the program. Features of the program include utilities to determine the velocity of propagation of the GPR signal and the location of the ground surface as well as semi-automatic and automatic processing of the data. The program is designed to operate on an IBM PC or compatible computer. Other hardware and supporting software requirements for operating the program are specified in Appendix B. GRA

N88-29060# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
RANDOM-ACCESS ALGORITHMS FOR ENVIRONMENTS WITH CAPTURE Technical Report, 1 Sep. 1986 - 31 Aug. 1988
P. Papantoni-Kazakos and D. F. Lyons 19 Apr. 1988 77 p
(Contract N00014-86-K-0742)
(AD-A194303; UVA/525415/EE88/113) Avail: NTIS HC A05/MF A01 CSCL 25B

Communication networks have seen a remarkable rise in both applications and theoretical study in the past twenty years. An increased demand for flexible and easily modified communication systems has supported recent interest in applications of communication networks to a wide variety of problems such as mobile packet radio, distributed sensor systems, satellite networks, and a plethora of applications in integrated computer communications. Such systems are typically characterized by a large number of users attempting to communicate with a central node via a common communication media. The multiaccess communication problem examines how to utilize most efficiently the available communication resources. This thesis proposes two random-access algorithms appropriate for operation in networks employing capture (that is, the correct reception of a single transmission in the presence of multiple transmissions). Both the paradigmatic ternary-feedback model as well as an enriched-feedback scheme are considered. After observing the regenerative properties of these algorithms, several results from renewal theory are employed to compute the throughput and delay characteristics of the proposed algorithms. It is shown that significant performance improvements (as compared to non-capture systems) are possible using systems with capture and employing appropriate random-access algorithms. Extensive numerical results are included. GRA

N88-29061# Naval Ocean Systems Center, San Diego, Calif.
EFFECT OF PHASE ERRORS IN STEPPED-FREQUENCY RADAR SYSTEMS Final Report, Jan. 1987 - Jan. 1988
H. E. VanBrundt Apr. 1988 12 p
(AD-A194476; AD-E500985; NOSC/TR-1211) Avail: NTIS HC A03/MF A01 CSCL 17I

Stepped-frequency waveforms are being considered for inverse synthetic aperture radar (ISAR) imaging from ship and airborne platforms and for detailed radar cross section (RCS) measurements of ships and aircraft. These waveforms make it possible to achieve resolutions of 1.0 foot by using existing radar designs and processing technology. One problem not yet fully resolved in using stepped-frequency waveform for ISAR imaging is the deterioration in signal level caused by random frequency error. Random frequency error of the stepped-frequency source results in reduced peak responses and increased null responses. The resulting reduced signal-to-noise ratio is range dependent. Two of the major concerns addressed in this report are radar range limitations for ISAR and the error in calibration for RCS measurements caused by differences in range between a passive reflector used for an RCS reference and the target to be measured. In addressing these concerns, NOSC developed an analysis to assess the tolerable frequency error in terms of resulting power loss in signal power and signal-to-phase noise. GRA

N88-29062# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
IMPROVEMENTS IN TECHNIQUES OF MICROWAVE THERMOGRAPHY Final Scientific Report, 15 Nov. 1982 - 30 Jun. 1985
Alan H. Barrett Feb. 1988 19 p
(Contract DAMD17-83-C-3025; DA Proj. 3M1-61102-BS-10)
(AD-A194613) Avail: NTIS HC A03/MF A01 CSCL 06E

This period of research concentrated in the following areas: (1) The development and testing of a reflection-compensating radiometer. (2) A theoretical investigation of the variation of microwave penetration depth in human tissue as a function of the aperture size of the contract antenna. (3) Antenna design to give improved penetration depth. (4) A study of the utility of bistatic measurements to detect embedded tumors and aid microwave thermography and hyperthermia. This report is subdivided into these four main sections. GRA

N88-29063# Photometrics, Inc., Woburn, Mass.
PROGRAM TO INCREASE THE MEASUREMENT CAPABILITIES OF THE AFGL (AIR FORCE GEOPHYSICS LABORATORY) FIXED AND MOBILE HIGH ALTITUDE LIDAR SYSTEMS Final Technical Report, 26 Sep. 1984 - 30 Oct. 1987
Warren P. Moskowitz and Gilbert Davidson 31 Mar. 1988 17 p
(Contract F19628-84-C-0085)
(AD-A194614; PHM-TR-88-05; AFGL-TR-88-0102) Avail: NTIS HC A03/MF A01 CSCL 17I

The capabilities of the AFGL fixed and mobile (GLEAM and GLINT) high altitude lidar systems have been enhanced to include sodium fluorescence measurement capability and daytime Rayleigh backscatter measurement capability. A detector system has been designed and fabricated for the 24 inch telescope in the mobile system which includes a Fabry-Perot etalon to allow daytime measurements. Operational support has been provided during field programs to Wallops Island, Virginia, and to the Poker Flat Rocket Research Range, Alaska, and during experiments at the fixed location. GRA

N88-29064# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AUTOMATIC CLASSIFICATION OF DIGITALLY MODULATED SIGNALS M.S. Thesis
Martin P. DeSimio Dec. 1987 126 p
(AD-A194623; AFIT/GE/ENG/87D-15) Avail: NTIS HC A07/MF A01 CSCL 12I

This experiment investigates the performance of an adaptive technique for the classification of the following types of digitally modulated signals: binary amplitude shift keying (BASK), binary

phase shift keying (BPSK), quaternary phase shift keying (QPSK), and binary frequency shift keying (BFSK). The feature extraction process uses the mean and variance of the signal, and magnitudes and locations of the maxima in the spectrum of the signal, the spectrum of the signal squared, and the spectrum of the signal raised to the fourth power. The process of raising the signal to the second and fourth power and searching for narrowband energy near twice and four times the intermediate frequency is shown to provide useful information for the classification of BPSK and QPSK signals. A computer simulation is performed to measure the properties of the classifier. First, the classifier is trained with a set of feature vectors calculated from 20 dB SNR signals. The Least Mean Squares (LMS) algorithm is the adaptive procedure used to generate the weight vectors used to form the linear decision functions. GRA

N88-29065# Naval Postgraduate School, Monterey, Calif.
USE OF A COHERENT SQUARE WAVE REFERENCE TO DEMODULATE BPSK (BINARY PHASE SHIFT KEYING) CARRIERS AND A VISUAL INDICATOR OF THE QUALITY OF RECEIVED QPSK (QUADRATURE PHASE SHIFT KEYING) CARRIERS M.S. Thesis
Mehmet K. Tok Dec. 1987 130 p
(AD-A193528) Avail: NTIS HC A07/MF A01 CSCL 25E

This report consists of two parts. Part 1 compares the noise performance of a coherent phase demodulator when using as a carrier reference a square-wave signal versus a sinusoidal signal. Analyses for both signal references are included for the cases of allpass noise and of bandpass noise at the demodulator input. The theory indicates the demodulator operating with either the square-wave signal or the sinusoidal signal as a carrier will result in identical noise performance for the theoretical case of bandpass noise. However, experimental results demonstrate that the demodulator operating with the square-wave signal has a 0.4 dB performance advantage for digital data transmission using binary phase shift keying, when compared under similar conditions to operations with the sinusoidal reference signal. Part 2 investigates the features of a visual indicator (x-y oscilloscope display) depicting the quality of received quadrature phase shift keyed carriers. Such display allows for visualization of the signal-degrading effects due to noise, channel bandlimiting induced ISI, and multipath propagation. The observed pattern formed by the visual indicator allows an operator to determine these channel impairments. With experience, an operator can assess the system probability of a bit error under a variety of operating conditions. GRA

N88-29066# Rome Air Development Center, Griffiss AFB, N.Y.
A NOVEL METHOD TO CORRECT RADIATION PATTERN DISTORTION OF CONFORMAL ANTENNAS
John D. Antonucci and Peter R. Franchi Jul. 1987 55 p
(AD-A193675; RADC-TR-87-139) Avail: NTIS HC A04/MF A01 CSCL 09A

The radiation pattern of a curved phased array antenna is distorted when the beam is scanned. This is primarily due to the change of the appearance of the amplitude taper across the aperture which is a consequence of curvature. The approach described in this report, to correct for this phenomenon, is to adjust the aperture taper as a whole, rather than to adjust each individual radiating element separately. If an anti-symmetric taper is added in the proper proportion to a symmetric taper the original taper can be largely recovered. Typically the sum and difference aperture illuminations of an antenna can provide the needed symmetric and anti-symmetric functions. A relatively simple and practical technique of using the sum and difference networks in combination to correct for curvature effects is demonstrated. This technique uses a variable power divider to distribute the power in a prescribed proportion at an arbitrary scan angle to the sum and difference channels. The optimum amount of signal to be distributed to achieve the maximum restoration is found as a function of scan angle and curvature. The analysis is comprehensive, including effects due to the element pattern, antenna size, and the variation of apparent element density. Since attenuators are not used, the method has the added advantage of experiencing no loss of power. The technique can be used to improve any sum and difference illuminations. GRA

N88-29067# SRI International Corp., Menlo Park, Calif.
HIERARCHICAL ORGANIZATION FOR LARGE, DYNAMIC RADIO NETWORKS Final Report, 1 Mar. 1984 - 31 Dec. 1987
Nachum Shacham Jan. 1988 28 p
(Contract DAAG29-84-K-0042; DA Proj. 1L1-61102-BH-57)
(AD-A193942; SRI-ECU-6975; ARO-20948.10-EL) Avail: NTIS HC A03/MF A01 CSCL 25B

As new technology is incorporated into weapons and command and control systems, the need for data communications and data processing at the tactical level will increase dramatically. Tactical ground forces are mobile and they operate in a highly stressed environment complete with noise, false messages and attrition of communication resources. Packet radio network (PRNET) is a promising technology that can serve tactical data communication applications if its architecture and the functionality of its protocols is enhanced to allow it to adapt to frequently changing environment and incorporation of a large number of users. Developing such architectures and protocols for large, survivable PRNETs and evaluating their performance were the principal thrusts of this research project. The main advances made in this effort include development of architectures and algorithms that fall in the following categories: (1) Hierarchical architectures and routing for dynamic networks; (2) Multichannel networks--architectures and protocols; (3) Dynamic selection of radio FEC code rate to adapt to channel variations; (4) Broadcast algorithms that provide for transport of messages to multiple destinations amidst topological changes; (5) Self-organizing networks in which the nodes control their local connectivity. The correctness of some algorithms was validated analytically; others were tested by simulations. GRA

N88-29068# Naval Postgraduate School, Monterey, Calif.
THE SPATIAL AND TEMPORAL VARIABILITY OF THE ARCTIC ATMOSPHERIC BOUNDARY LAYER AND ITS EFFECT ON ELECTROMAGNETIC (EM) PROPAGATION M.S. Thesis
Zdenka S. Willis Dec. 1987 109 p
(AD-A193958) Avail: NTIS HC A06/MF A01 CSCL 20N

Gradients of temperature, pressure and moisture affect the propagation of electromagnetic (EM) waves. Navy systems which are dependent on EM propagation can be either enhanced or degraded due to atmospheric conditions which affect atmospheric refractive index profiles. The Navy's model for predicting the refractive index is the Integrated Refractive Effects Prediction System (IREPS) version 2.2, developed by the Naval Ocean Systems Center (NOSC). Atmospheric parameters of temperature, vapor pressure and relative humidity - with relative humidity being the most critical - are used by IREPS to predict the atmospheric refractivity. GRA

N88-29069# Communications Research Centre, Ottawa (Ontario).
THE 44/20 GHz GROUND TERMINAL
A. H. McEwen Aug. 1987 64 p
(AD-A194002; CRC-1428) Avail: NTIS HC A04/MF A01 CSCL 25E

The design and construction of an extremely high frequency (EHF) SATCOM terminal to transmit in the mobile satellite (43.5 to 45.5) GHz band and receive in the fixed satellite space to earth (20.2 to 21.2) GHz band is described. Characterization plots for individual RF system components and test results of the complete terminal operating over a 16 km repeater range are shown. GRA

N88-29070# International Centre for Theoretical Physics, Trieste (Italy).
DISTORTIONS IN PROCESSED SIGNALS AND THEIR APPLICATION IN ELECTRONIC DESIGN. PART 1: BASIC AND GENERAL FORMULATIONS
E. C. Njau Oct. 1987 16 p

(DE88-702731; IC-87/340) Avail: NTIS (US Sales Only) HC A03/MF A01

Complete analytical expressions for the distortion signals introduced into analogue signals by sampling and quantization processes are developed. These expressions are made up of terms that are wholely functions of the parameters of the original signals involved and hence are easy to evaluate numerically. It is shown in Parts 2 and 3 of this series that these expressions may be successfully used in the design and development of some electronic devices whose operation depends upon the above-named distortion signals. DOE

N88-29071# International Centre for Theoretical Physics, Trieste (Italy).

DISTORTIONS IN PROCESSED SIGNALS AND THEIR APPLICATION IN ELECTRONIC DESIGN. PART 2: A NEW VARIABLE SIGNAL GENERATOR

E. C. Njau Oct. 1987 9 p

(DE88-702732; IC-87/341) Avail: NTIS (US Sales Only) HC A02/MF A01

We describe the main design and operational features of a new type of variable audiofrequency signal generator. Unlike the conventional signal generators, this generator operates principally on the basis of distortions introduced into two oscillator-generated sinusoidal signals by a double sampling process. Successful testing of the new signal generator is also reported. DOE

N88-29072# International Centre for Theoretical Physics, Trieste (Italy).

DISTORTIONS IN PROCESSED SIGNALS AND THEIR APPLICATION IN ELECTRONIC DESIGN. PART 3: AN AUTOMATED GENERATOR OF COMMUNICATION JAMMING SIGNALS

E. C. Njau Oct. 1987 11 p

(DE88-702733; IC-87/342) Avail: NTIS (US Sales Only) HC A03/MF A01

We describe the design and operational features of a simple electronic circuit that is capable of automatically generating a narrow bandwidth jamming signal around each frequency signal received from target transmitters. It is noted that jamming based upon this circuit is fairly difficult to nullify using some of the conventional counter jamming strategies since in this case the jamming signals are flexibly locked onto the spectral components of the received signals. DOE

N88-29073 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

INVESTIGATIONS ON MULTIPORT ANTENNAS FOR POLARIMETRIC AND MODAL FIELD SCANNING

O. Schmid, W. Soentgerath, Chr. vonWinterfeld, and E. Zocher Jun. 1987 47 p In GERMAN; ENGLISH summary

(Contract BMVT-T/RF-31/D0037/D1332)

(Rept-5-87; Lfd-262; ETN-88-92972) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514

Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

Concepts for multiport antennas with different geometries were investigated. The polarimetric tracking for a plane, circular sensor antenna, as well as the geometry dependence of the cylindrical spectrum of the characteristic of a conical antenna were theoretically analyzed with a view to polarization perturbation. Experimental antennas with cylindrical and conical geometry were realized in the X-band, and their radiation properties were investigated with respect to polarization and directional interference. ESA

N88-29074 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

EXPERIMENTAL INVESTIGATIONS FOR THE GENERATION OF PHASE MODES FOR ADAPTIVE ANTENNAS [EXPERIMENTELLE UNTERSUCHUNG ZUR ERZEUGUNG VON PHASENMODEN FUER ADAPTIVE ANTENNEN]

W. Soentgerath Nov. 1987 28 p In GERMAN; ENGLISH summary

(Contract BMVT-FOA-T/RF-31/D0037/D1332)

(Rept-10-87; Lfd-267; ETN-88-92973) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514

Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

A circular array antenna with 32 elements and with phase-mode excitation using a suitable feeder network was investigated. The principle of sidelobe cancellers is explained. Theoretical considerations concerning arrays with phase-mode excitation are given. The experimental system is described. It is found that the far field pattern of each mode has a constant amplitude and a linearly varying phase angle. This kind of pattern can be used for interference suppression following the sidelobe canceller principle. ESA

N88-29075 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

DEVELOPMENT OF A MULTIPORT-HYBRID-MODE EXCITER FOR USE IN ANTENNAS FOR POLARIMETRIC FIELD MEASUREMENTS

E. Zocher Dec. 1987 70 p In GERMAN; ENGLISH summary

(Contract BMVT-T/RF-31/D0037/D1332)

(Rept-12-87; Lfd-269; ETN-88-92974) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514

Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

A multiport hybrid mode exciter with axial mode feed, generating each of the two orthogonally polarized sum and difference radiation patterns was developed. The modes TE11, TE11*, TE01, TM01 excited by mode couplers in different sections of the circular main waveguide are transferred using a conical corrugated transition to hybrid modes HE11, HE11* and to the classical modes of the TE01 and the TM02 type in the next cylindrical corrugated waveguide section. These modes are radiated by a conical corrugated horn. The principles applied for the design of mode couplers and feed networks are illustrated. Using theoretical results, the dimensioning of the corrugated waveguide components with reduced disturbing modes is explained. The measured radiation patterns show good rotational symmetry, low sidelobes and very small cross polarization levels. ESA

N88-29076* National Aeronautics and Space Administration. Pasadena Office, Calif.

DIGITAL PHASE-LOCK LOOP HAVING AN ESTIMATOR AND PREDICTOR OF ERROR Patent

Joseph I. Statman, inventor (to NASA) and William J. Hurd, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 13 Sep. 1988 17 p

(NASA-Case-NPO-17196-1-CU; US-Patent-4,771,250; US-Patent-Appl-SN-084770; US-Patent-Class-331-17; US-Patent-Class-331-25; US-Patent-Class-328-155) Avail: US Patent and Trademark Office CSCL 17B

A digital phase-lock loop (DPLL) which generates a signal with a phase that approximates the phase of a received signal with a linear estimator. The effect of a complication associated with non-zero transport delays related to DPLL mechanization is then compensated by a predictor. The estimator provides recursive estimates of phase, frequency, and higher order derivatives, while the predictor compensates for transport lag inherent in the loop.

Official Gazette of the U.S. Patent and Trademark Office

N88-29077*# Analex Corp., Cleveland, Ohio.

A STATISTICAL RAIN ATTENUATION PREDICTION MODEL WITH APPLICATION TO THE ADVANCED COMMUNICATION TECHNOLOGY SATELLITE PROJECT. 1: THEORETICAL DEVELOPMENT AND APPLICATION TO YEARLY PREDICTIONS FOR SELECTED CITIES IN THE UNITED STATES Final Report

Robert M. Manning Sep. 1986 206 p

(Contract NAS3-24564)

(NASA-CR-179498; E-3187; NAS 1.26:179498) Avail: NTIS HC A10/MF A01 CSCL 20N

A rain attenuation prediction model is described for use in calculating satellite communication link availability for any specific location in the world that is characterized by an extended record

of rainfall. Such a formalism is necessary for the accurate assessment of such availability predictions in the case of the small user-terminal concept of the Advanced Communication Technology Satellite (ACTS) Project. The model employs the theory of extreme value statistics to generate the necessary statistical rainrate parameters from rain data in the form compiled by the National Weather Service. These location dependent rain statistics are then applied to a rain attenuation model to obtain a yearly prediction of the occurrence of attenuation on any satellite link at that location. The predictions of this model are compared to those of the Crane Two-Component Rain Model and some empirical data and found to be very good. The model is then used to calculate rain attenuation statistics at 59 locations in the United States (including Alaska and Hawaii) for the 20 GHz downlinks and 30 GHz uplinks of the proposed ACTS system. The flexibility of this modeling formalism is such that it allows a complete and unified treatment of the temporal aspects of rain attenuation that leads to the design of an optimum stochastic power control algorithm, the purpose of which is to efficiently counter such rain fades on a satellite link.
Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N88-29078# Army Materiel Command, Tobyhanna, Pa. Packaging Storage and Containerization Center.
PROCEDURES FOR IDENTIFICATION AND HANDLING OF PRINTED CIRCUIT BOARDS (PCBS)
Dec. 1987 20 p
(AD-A191177) Avail: NTIS HC A03/MF A01 CSCL 09A

Presently, the Army is faced with two major problems concerning handling and identifying printed circuit boards (PCBs): (1) Many PCBs are damaged within the repair and supply cycle from electrostatic discharge (ESD) or electromagnetic induction (EMI), (2) PCBs are lost because supply personnel are unable to identify them, this damage or loss costs us, the taxpayer, a lot of money. It is estimated that the average cost of a PCB is in the neighborhood of $1,000. Normally, it is the responsibility of supply personnel to package repairable return items to protect them throughout the supply cycle. Some items, however, must have some protective packaging applied before they can be routed to the supply unit. All items which are sensitive to ESD must not only be protected from normal handling environs such as climatic, shipping, and storage; they must also be protected from ESD. GRA

N88-29079# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
BASIC RESEARCH IN ELECTRONICS (JSEP) JOINT SERVICES ELECTRONICS PROGRAM Annual Report, 1 Jan. - 31 Dec. 1987
Arthur A. Oliner and Erich E. Kunhardt 31 Dec. 1987 128 p
(Contract F49620-85-C-0078)
(AD-A193072; POLY-WRI-1533-88; AFOSR-88-0275TR) Avail: NTIS HC A07/MF A01 CSCL 09A

The contents of this report on the basic research program of the Joint Service and Electronics Program are as follows: New Physical Effects Involving Open Dielectric Structures; Beam-Wave Propagation and Interactions in Open Layered Media; Mixed Spectral Techniques for Wave Propagation and Diffraction; X-Ray Coupled Wave Interactions at Crystal Surfaces; Microstructure Photophysics; Dynamical and Non-Equilibrium Properties of Surface and Interfaces; Infrared-Laser-Induced MOCVD; Resonant Interactions in Crystals at X-Ray Wavelength Surfaces; Robust and Linear Filtering Detection and Estimation in Telecommunications, Radar, and Sonar Problems; A Raised Power Test and Some of its Applications in Array Signal Processing.
GRA

N88-29080# Brown Univ., Providence, R. I. Div. of Engineering.
DEVELOPMENT AND EXPERIMENTAL VERIFICATION OF A TWO-DIMENSIONAL NUMERICAL MODEL OF PIEZOELECTRICALLY INDUCED THRESHOLD VOLTAGE SHIFTS IN GaAs MESFETs
Jean-Claude Ramirez, Patrick J. McNally, Lisa S. Cooper, James J. Rosenberg, L. B. Freund, and T. N. Jackson (IBM Watson Research Center, Yorktown Heights, N.Y.) Jan. 1988 33 p
(Contract N00014-87-K-0481; Grants NSF DMR-87-14665; NSF ECS-84-51523)
(AD-A193462) Avail: NTIS HC A03/MF A01 CSCL 09A

The results of a combined experimental and analytical investigation of the effects of mechanical stress on dc electrical parameters, particularly threshold voltage, in MESFETs are reported. The theoretical aspect of this study involves a two-dimensional finite element simulation of the same device structure on which measurements were made. In contrast with an approximate analytical calculation reported in the literature in which the stress concentrations which occur at the gate edges were represented by concentrated line forces acting in the plane of the substrate surface, the substrate stresses and resultant piezoelectric charge distributions calculated in this study take into account the two-dimensional nature of the geometry of the gate. Accounting for the two-dimensional nature of the overlayer yields piezoelectric charge distributions that differ from those predicted using the more approximate concentrated force model. The experimental portion of this study involves measurement of dc parameters of devices during the application of external mechanical loads. These loads are intended to simulate mechanical stresses which arise during device processing. By introducing this stress without any additional thermal processing, the impact of residual stresses via the piezoelectric effect on parameters such as threshold voltage can be examined separately from other effects, such as stress enhanced diffusion. It is found that the piezoelectric effect can account for most of the anomalous shift in threshold voltage observed in real GaAs devices. GRA

N88-29081# Purdue Univ., West Lafayette, Ind.
DARPA-URI CONSORTIUM MEETINGS ON SUBMICRON HETEROSTRUCTURES OF DILUTED MAGNETIC SEMICONDUCTORS Annual Report
1987 47 p
(Contract N00014-86-K-0706)
(AD-A193499) Avail: NTIS HC A03/MF A01 CSCL 20C

The Principal Investigators along with their co-investigators are continuing to maintain high visibility in the area of II-VI semiconductors and their heterostructures with special emphasis and focus on the diluted magnetic semiconductors (DMS's). The enclosed list of publications during 1986 to 1987 documents the high level of activity and the interactive climate which prevails in the Consortium. The enclosed list of invited talks, seminars and colloquia, and contributed talks shows that the semiconductor community continues to have intense interest in the area of focus of the Consortium. GRA

N88-29082# Sandia National Labs., Albuquerque, N. Mex.
EVALUATION OF SILICON-ON-INSULATOR MOS (METAL-OXIDE-SEMICONDUCTOR) TRANSISTOR RESPONSE TO 10-keV X-RAY AND COBALT-60 IRRADIATION
D. M. Fleetwood, S. S. Tsao, and P. S. Winokur 1988 5 p
Presented at the 25th Annual Conference on Nuclear and Space Radiation Effects, Portland, Oreg., 12 Jul. 1988
(Contract DE-AC04-76DP-00789)
(DE88-006102; SAND-88-0250C; CONF-880730-1) Avail: NTIS HC A02/MF A01

This front-gate, back-gate, and sidewall response of SIMOX and ZMR MOS transistors to 10-keV X-ray and Co-60 irradiation is compared for SOI devices with and without hardened sidewall passivation. DOE

N88-29083# Los Alamos National Lab., N. Mex.
RECENT ADVANCES IN HIGH-POWER MICROWAVE AMPLIFIERS

D. W. Reid 1988 4 p Presented at the IEEE MTT-S International Microwave Symposium, New York, N.Y., 25 May 1988
(Contract W-7405-eng-36)
(DE88-007820; LA-UR-88-1070; CONF-880565-3) Avail: NTIS HC A02/MF A01

Recent advances in microwave amplifiers have increased efficiencies and power levels at frequencies from 0.3 to 150 GHz. These improvements have occurred in both solid-state and vacuum-tube systems. Of special note is the very high power device where power levels of 1 GW are routinely generated. This paper will review the latest results of these R and D efforts. DOE

N88-29084# Sandia National Labs., Albuquerque, N. Mex.
HPM (HIGH-POWER MICROWAVE) COUPLING INTO REALISTIC TARGETS
L. D. Bacon, J. F. Aurand, and R. P. Toth 1988 14 p Presented at the 4th National High Power Microwave Conference, Monterey, Calif. 9 May 1988
(Contract DE-AC04-76DP-00789)
(DE88-011788; CONF-8805132-5) Avail: NTIS HC A03/MF A01

High-Power Microwave (HPM) coupling into targets of interest is extremely difficult to assess analytically or numerically. The practicalities of accurately modeling physical structures, as well as the subtlety of determining which simplifications are allowable for the accuracy needed, require that target interaction calculations be verified by careful laboratory measurements. In addition, the differences in construction techniques and tolerances on joints and seams make an experimental scan of the parameter space essential if we are to establish rules-of-thumb for coupling into systems. To meet this need for a benchmark for HPM coupling calculations, we have designed and constructed several RF shielding enclosures with generic but realistic joints and seams. We measured the coupling of RF into these enclosures over the frequency range of 45 MHz to 18 GHz, recording both amplitude and phase information. These data allow us to evaluate the response of various ports-of-entry to both continuous wave and pulsed sources. We can see trends with frequency for various port of entry types that relate to relatively simple geometric factors. DOE

N88-29085# European Organization for Nuclear Research, Geneva (Switzerland).
PSEUDOSPARK SWITCHES
P. Billault, H. Riege, M. vanGulik, E. Boggasch, K. Frank, and R. Seeboeck 14 Dec. 1987 35 p
(DE88-702227; CERN-87-13) Avail: NTIS (US Sales Only) HC A03/MF A01

The pseudospark discharge is bound to a geometrical structure which is particularly well suited for switching high currents and voltages at high power levels. This type of discharge offers the potential for improvement in essentially all areas of switching operation: peak current and current density, current rise, stand-off voltage, reverse current capability, cathode life, and forward drop. The first pseudospark switch was built at CERN at 1981. Since then, the basic switching characteristics of pseudospark chambers have been studied in detail. The main feature of a pseudospark switch is the confinement of the discharge plasma to the device axis. The current transition to the hollow electrodes is spread over a rather large surface area. Another essential feature is the easy and precise triggering of the pseudospark switch from the interior of the hollow electrodes, relatively far from the main discharge gap. Nanosecond delay and jitter values can be achieved with trigger energies of less than 0.1 mJ, although cathode heating is not required. Pseudospark gaps may cover a wide range of high-voltage, high-current, and high-pulse-power switching at repetition rates of many kilohertz. This report reviews the basic research on pseudospark switches which has been going on at CERN. So far, applications have been developed in the range of thyratron-like medium-power switches at typically 20 to 40 kV and 0.5 to 10 kA. High-current pseudospark switches have been built for a high-power 20 kJ pulse generator which is being used for long-term tests of plasma lenses developed for the future CERN Antiproton Collector (ACOL). The high-current switches have operated for several hundred thousand shots, with 20 to 50 ns jitter at 16 kV charging voltage and more than 100 kA peak current amplitude. DOE

N88-29086# Illinois Univ., Chicago. Dept. of Electrical Engineering and Computer Science.
ON BROADBAND MATCHING OF MULTIPORT ELECTRICAL NETWORKS WITH APPLICATIONS Final Report, Aug. 1984 - Sep. 1987
Wai-Kai Chen Jan. 1988 244 p
(Contract F33615-84-K-1556)
(AD-A194224; UIC-EECS-87-3; AFWAL-TR-87-1131) Avail: NTIS HC A11/MF A01 CSCL 09A

The objective of the research is to solve several problems of fundamental importance in the design of broadband matching networks and multiplexers. More specifically, we investigate the following: (1) Obtain a set of coefficient constraints that are necessary and sufficient for a real rational matrix to be the scattering matrix of a passive n-port network normalizing to the n prescribed non-foster positive-real impedances. (2) Derive a set of coefficient constraints that are necessary and sufficient for the existence of a lossless reciprocal n-port network, which, when terminated in the n given frequency-dependent loads, realizes the prescribed transducer power-gain characteristics among its ports. The relationships between the broadband matching of many ports and the design theory of multiplexers are studied, and the known results in the theory of broadband matching to minimize the interaction effects of the individual channels are applied. GRA

N88-29087# Hughes Aircraft Co., Torrance, Calif. Microwave Products Div.
METAL GRID BASE HETEROJUNCTION TRANSISTOR OPERATING AT 60 AND 94 GHz Interim Report No. 1, Sep. 1986 - Sep. 1987
H. Yamasaki, S. X. Bar, B. M. Paine, and M. J. Tejwani Apr. 1988 52 p
(Contract N66001-86-C-0438; ARPA Order 4766)
(AD-A194763; NOSC/TD-1250) Avail: NTIS HC A04/MF A01 CSCL 09A

This program is for the development of a new device structure, the Metal Gridded Base Heterojunction Transistor (MGBHT). The device is an AlGaAs/GaAs bipolar structure, and incorporates a metal grid for reduction of the base resistance relative to a standard heterojunction transistor. In this reporting period, the device has been modeled analytically to verify performance potential and determine the required process parameters. Techniques for preparation of the metal grids have been developed, first with T-W, and later with pure W. Extensive experiments were conducted on epitaxial growth of GaAs and AlGaAs over the metal, and doping of GaAs and AlGaAs. Epitaxy is by metal-organic chemical vapor deposition, and Be and Zn have been used as the p-type dopants. A complete overhaul of the MOCVD reactor was completed in order to accommodate the Be dopant, as well as for incorporating very slow growth rates (50 to 100 A/min). To date, Be doping has been achieved to levels of 2 x 10 to the 19th power at/cu cm, with layer abruptnesses of about 100 A. GRA

N88-29088# Naval Postgraduate School, Monterey, Calif.
NATURAL CONVECTION IMMERSION COOLING OF AN ARRAY OF SIMULATED CHIPS IN AN ENCLOSURE FILLED WITH DIELECTRIC LIQUID M.S. Thesis
Turgay Pamuk Dec. 1987 71 p
(AD-A193594) Avail: NTIS HC A04/MF A01 CSCL 09A

An experimental natural convection heat transfer study of a simulated electronic circuit board has been conducted. The board has an array of 9 simulated chips, each dissipating up to 2.5 Watts. The board is immersed in FC75, a fluorocarbon liquid, in an enclosure whose top and bottom surfaces are constant temperature heat sinks. The experimental data have been expressed in terms of relevant dimensionless heat transfer

parameters such as Nusselt and Rayleigh numbers. It appears that the chips located higher in the enclosure have lower heat transfer rates. Otherwise the chips in the same row behave in a similar way which implies a quasi-two dimensionality. GRA

N88-29089# Rome Air Development Center, Griffiss AFB, N.Y.
RELIABILITY ASSESSMENT OF SURFACE MOUNT TECHNOLOGY (SMT) Report, Dec. 1985 - Aug. 1987
Gretchen A. Bivens Mar. 1988 40 p
(AD-A193759; RADC-TR-88-72) Avail: NTIS HC A03/MF A01 CSCL 09A

This report documents an in-house study that was conducted in order to assess the current reliability problems associated with surface mount technology (SMT). Specific areas investigated included failure modes, design guidelines, reliability prediction techniques and reliability evaluation test methods associated with SMT. A Literature search was conducted and many IR and D programs were reviewed. The results showed a considerable amount of research in the area of SMT failure modes and in the development of SMT design guidelines. The two areas that were deficient were the development of a reliability prediction technique for SMT and the appropriateness of current reliability evaluation test methods. GRA

N88-29090# Israel Inst. of Metals, Haifa.
LASER AND ELECTROCHEMICAL STUDIES OF METALLIZATIONS IN ELECTRONIC DEVICES Annual Research Report No. 2, 1 Sep. 1986 - 31 Aug. 1987
J. Zahavi, M. Rotel, and B. Dobbs Dec. 1987 57 p
(Grant AF-AFOSR-0315-86)
(AD-A193786; EOARD-TR-88-03) Avail: NTIS HC A04/MF A01 CSCL 09C

The research during this year was concerned with application of excimer laser (193 nm, 24 nsec, 10 to the 6th power to 10 to the 7th power watt/sq cm pulse) to Pb-Sn surfaces. The laser induced melting of the Pb-Sn coating resulted in a bright area in which lead-rich zones were observed. Perferential dissolution of lead was observed during electrochemical potentiodynamic polarization of both the as-deposited and laser treated surfaces. Calculation showed that the laser-treated specimen had higher corrosion rates than as-deposited counter-parts. GRA

N88-29091# Aerojet Electrosystems Co., Azusa, Calif.
SPACE-CHARGE-WAVE SOLID STATE MICROWAVE AMPLIFIER Final Report, Sep. 1986 - Oct. 1987
B. G. Martin 31 Dec. 1987 61 p
(Contract DAAL03-86-C-0016)
(AD-A193792; ARO-23444.1-PH) Avail: NTIS HC A04/MF A01 CSCL 09A

The feasibility of a device utilizing the GaAs/AlGaAs HEMT structure for amplifying microwaves is investigated. The following accomplishments were made: (1) the number of design considerations bearing on concept feasibility were investigated, e.g., carrier scattering losses, LO phonon creation, penetration depth of microwaves into HEMT structure, etc. Based on these considerations, the concept appears feasible; (2) Fabrication techniques were developed for interdigital electrode slow-wave circuits and ohmic contacts on HEMT structure; (3) Several prototype devices were fabricated and tested. A result of this was that coupling of microwaves (at GHz frequencies) to the HEMT channel electrons was demonstrated; and (4) Theoretical work showed that the TO phonons in doped GaAs behave as the resistive wall necessary for electromagnetic wave amplification. In addition, an investigation was made of the interaction of electromagnetic waves and drifting electrons in a model of a HEMT structure. Amplifying instabilities are in evidence. It is concluded that the subject device appears feasible, but further and extensive experimental work is required. Author (GRA)

N88-29092# Air Force Weapons Lab., Kirtland AFB, N. Mex.
FREQUENCY DOUBLING AT 1.315 MICROMETERS Final Report, Sep. 1984 - Aug. 1985
R. H. Humphreys, Daniel E. Johnson, P. Keating, and G. D. Hager Feb. 1988 26 p
(AD-A193902; AFWL-TR-87-54) Avail: NTIS HC A03/MF A01 CSCL 09C

Using lithium iodate crystals, second harmonic generation of chemical oxygen iodine laser (COIL) light (gamma = 1.315 mircometer) has been demonstrated for the first time. Both a photolytic iodine laser and a COIL were used. For the photolytic iodine laser, 320 mW of red output in 40 microsecond pulses was generated in an extracavity configuration at a conversion efficiency of 2.1 x 10 to the minus 5th power. With the COIL device, 60 mW of average second harmonic power was observed at an overall conversion efficiency of 1 percent when the crystal was placed intracavity. In both cases, experimental second harmonic powers were in good agreement with theoretical values. GRA

N88-29093# Naval Postgraduate School, Monterey, Calif.
COMPUTER AIDED FILTER DESIGN M.S. Thesis
Hsueh-wen Liu Dec. 1987 86 p
(AD-A193959) Avail: NTIS HC A05/MF A01 CSCL 12E

Digital filter design has become instrumental in many fields of electronics. The objectives of this work is to study the benefit of using computer design tools to find equivalent digital filter realizations of analog filters. An analog video bandpass filter for TV Intermediate Frequency signal extraction was selected as an example. First we introduce the Finite Impulse Response filter (FIR) and the Remez program that is used for optimal FIR filter design. Other computer design tools such as ILS are used to design a number of existing bandpass filters. Emphasis was placed on the used of zero-one decomposition of filters to eliminate the number of multipliers and thus reduce hardware requirements. GRA

N88-29094# Spectra Technology, Inc., Bellevue, Wash.
LINEAR THYRATRON Final Report, 1984 - 1987
Mark J. Kushner and Michael VonDadelzson 31 Jul. 1987 232 p
(Contract F33615-84-C-2474)
(AD-A194111; AFWAL-TR-87-2080) Avail: NTIS HC A11/MF A01 CSCL 09A

A linear configuration thyratron was investigated experimentally and theoretically. Advantages of this configuration are lower inductance and the capability of increasing current capability by increasing the length of the device without increasing current density or inductance. The experimental device used a 10-cm-long dispenser type cathode, a baffled grid and an auxiliary grid. Several modifications were made improving vacuum quality, voltage-standoff or switching speed. The discharge volume could be analyzed using several viewing ports. Using the auxiliary grid, the discharge ignited uniformly over the whole length of the device, proving the linear concept. The distribution of the electron density was measured time resolved using Hook spectroscopy. The data were in good agreement with a numerical code using a spatial grid and time resolved solutions of the Poisson equation. The electrons were represented with normalized spatial densities (macro-electrons) and their motion calculated using Monte Carlo techniques and the appropriate elastic and inelastic collision cross sections. GRA

N88-29095*# National Aeronautics and Space Administration. Pasadena Office, Calif.
POWER SUPPLY CONDITIONING CIRCUIT Patent Application
Lori E. Primas, inventor (to NASA) and Rohan C. Loveland, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 8 Jul. 1988 19 p
(Contract NAS7-918)
(NASA-Case-NPO-17233-1-CU; NAS 1.71:NPO-17233-1-CU; US-Patent-Appl-SN-231025) Avail: NTIS HC A03/MF A01 CSCL 09A

A conditioning circuit is provided with a constant current diode in series with a zener diode, the former having a high dynamic impedance and the latter a low dynamic impedance. The constant current diode can receive an input voltage with PARD. In conjunction with the zener diode fixed to a ground, a voltage

divider is provided which can give an output voltage whose PARD was significantly reduced. The conditioning circuit is effective down to dc. NASA

N88-29096# Stuttgart Univ. (West Germany).
BAND PASS WITH CAVITY RESONATORS BY USE OF THREE OSCILLATION TYPES Ph.D. Thesis [BANDPAESSE MIT HOHLRAUMRESONATOREN UNTER AUSNUETZUNG VON DREI SCHWINGUNGSTYPEN]
Albrecht Linkohr 1987 92 p In GERMAN
(ETN-88-92984) Avail: NTIS HC A05/MF A01

Practical realization of cavity conductor multimode bandpass filter on the example of three mode filters is described. Cavity resonator dimensioning is performed where interdependent self oscillations of the same frequency are excited. Bandpass behavior is obtained by electric or magnetic coupling of single oscillation types. Advantages of three mode filters are weight and volume reduction. ESA

N88-29097# Royal Signals and Radar Establishment, Malvern (England).
TUNNELLING CURRENTS IN REVERSE BIASED CMT PHOTODIODES
N. T. Gordon Mar. 1988 22 p
(RSRE-Memo-4137; BR106077; ETN-88-93133) Copyright
Avail: NTIS HC A03/MF A01

An expression for the tunneling current in a general homojunction in cadmium mercury telluride is derived. This expression is used to predict the range of doping and bias where tunneling is a problem for thermal imaging. Techniques for reducing the tunneling current are considered. ESA

N88-29098*# National Aeronautics and Space Administration, Washington, D.C.
THE DIAMOND AS A NEW ELECTRONIC MATERIAL
Hans-Jurgen Schmitt and Hans Dammann Sep. 1988 28 p
Transl. into ENGLISH from Physik in Userer Zeit. (Fed. Republic of Germany), v. 18, no. 5, 1987 p 129-136 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20354; NAS 1.77:20354) Avail: NTIS HC A03/MF A01 CSCL 09A

Diamond promises to replace gallium arsenide as the prime high-technology electronic substance. Materials scientists worldwide are working on the development of diamond coatings as a replacement for gallium arsenide. Author

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-29099# Pennsylvania State Univ., University Park. Applied Research Lab.
STABILITY AND DRAG REDUCTION IN A BOUNDARY LAYER WITH MICROBUBBLES
Joao M. Neves Feb. 1988 138 p
(Contract N00024-85-C-6041)
(AD-A191975; ARL/PSU/TR-88-001) Avail: NTIS HC A07/MF A01 CSCL 20D

When microbubbles are injected in a turbulent boundary layer, they promote a reduction of the local skin friction and a sharp mean velocity gradient between the two microbubble free regions in the boundary layer, i.e., the outer edge and the near wall region. In connection with the apparent stability of the bubbles in the boundary layer, the stability of a hollow vortex sheet in an infinite expanse of fluid as well as in the presence of a wall are studied. We conclude that the simple hollow vortex sheet is unconditionally unstable while a stability range was found for a hollow vortex sheet perturbed in the presence of a wall. In all cases, however, the computations suggest that the hollow vortex radius is invariably a destabilizing factor. Regarding the second aspect of the problem, a heuristic, but physically sound explanation of the mechanisms of the drag reduction is proposed. Based on these ideas and using a phenomenological approach, the flat plate boundary layer is numerically analyzed. GRA

N88-29100 Georgia Inst. of Tech., Atlanta.
STEADY AND UNSTEADY INTERNAL FLOW COMPUTATIONS VIA THE SOLUTION OF THE COMPRESSIBLE NAVIER STOKES EQUATIONS FOR LOW MACH NUMBERS Ph.D. Thesis
John Apostolos Ekaterinaris 1987 262 p
Avail: Univ. Microfilms Order No. DA8800028

The objective is to approximate incompressible flow fields by low Mach number compressible solutions in order to solve unsteady internal flow problems. The advantage of this approach is that certain difficulties associated with the numerical solution of incompressible interal flows, such as the treatment of the pressure terms, are overcome. The full unsteady compressible Navier-Stokes equations are solved numerically for axisymmetric flows. The conservation law form of the governing equation is used and the calculations performed on a curvilinear coordinates system. The numerical integration is achieved with an implicit finite difference scheme using approximate factorization and alternate direction implicit techniques. Steady state solutions were obtained first for a variety of internal flow problems: flows in ducts with smooth constrictions, suddenly expanding ducts and dusts with a step constriction. The low Mach number compressible results are compared with available experimental data and incompressible solutions. The first test for the unsteady calculations was to approximate the classical incompressible Womersley flow by a low Mach number unsteady compressible solution. The agreement of the numerical results with the analytical solution was satisfactory. Dissert. Abstr.

N88-29101 Tennessee Univ., Knoxville.
THREE-DIMENSIONAL LASER DOPPLER VELOCIMETER STUDIES OF FLOW IN A 90 DEG CURVED DUCT HAVING A SQUARE CROSS-SECTION Ph.D. Thesis
Abdolhossein NouriNejad 1987 266 p
Avail: Univ. Microfilms Order No. DA8802688

Measured values of the three velocity components and the associated turbulent fluctuations are presented for the flow of air in a 90 degree bend of 10 x 10 in cross-section duct. The bend had a mean radius of 23.0 in and was located downstream of 40.0 in and upstream of 10.0 in straight sections. The experiments were carried out at two Reynolds numbers, based on the hydraulic diameter and bulk mean flow velocity, of 99400 and 332000, corresponding to Dean numbers of 46300 and 155000, respectively. A three-dimensional, tri-orthogonal and Bragg-diffracted laser Doppler velocimeter system was used to measure the flow velocity at nine successive streamwise locations. Extensive laser-light-screen smoke flow visualization was performed to identify qualitatively the characteristics of the flow. In addition, a Navier-Stokes computer code based on the Beam-Warming implicit, alternating-direction scheme was used as a numerical model. Experimental and computational results indicate that the flow patterns are complex and highly three-dimensional due to the formation of corner vortices. Dissert. Abstr.

N88-29102 Michigan Univ., Ann Arbor.
A SINGULAR PERTURBATION ANALYSIS OF THE WEAKLY NONLINEAR EVOLUTION OF LONG AND SHORT WATER WAVES AND WAVES IN BOUNDARY LAYERS Ph.D. Thesis
Stephen Laurence Woodruff 1987 136 p
Avail: Univ. Microfilms Order No. DA8801450

A singular-perturbation method is introduced for the solution of multiple-scale problems. The use of the method is first illustrated with some relatively simple ordinary and partial differential equations; it is then applied to two problems in fluid mechanics:

the nonlinear interaction of long and short water waves and boundary-layer stability. The proposed method is referred to as the invariance-condition to the straightforward expansion, which includes secular terms. A differential equation results. The solution to this is the required approximation for the original problem, with the secular term correctly accounted for. Three fairly standard examples of multiple-scale problems are used to introduce the method: linear oscillators with small damping and with slowly varying frequency and the Klein-Gordon equation with an additional, small, cubic term. In the application to long and short water waves, a nonlinear gravity wave interacts with a packet of small-amplitude capillary waves. The application to boundary-layer stability involves following evolution of a disturbance as it travels downstream. The disturbance is taken to be a small-amplitude wave packet and again a Ginzburg-Landau equation with variable coefficients is derived. Observations on the present method as compared with previous methods and possibilities for future work in the areas of water waves and boundary-layer stability are presented.
Dissert. Abstr.

N88-29103# Wisconsin Univ., Madison. Center for Mathematical Sciences.
A LIMITING VISCOSITY APPROACH TO THE RIEMANN PROBLEM FOR MATERIALS EXHIBITING CHANGE OF PHASE Technical Summary Report
M. Slemrod Sep. 1987 47 p
(Grant AF-AFOSR-0239-85)
(AD-A193477; CMS-TSR-88-6) Avail: NTIS HC A03/MF A01 CSCL 20D

This paper considers resolution of the Riemann problem for a van der Waals fluid. The method of an analysis is one of limiting artificial viscosity.
GRA

N88-29104# Wisconsin Univ., Madison. Center for Mathematical Sciences.
COMPUTATION OF THE EIGENVALUES FOR PERTURBATIONS OF POISEUILLE FLOW USING A TWO-POINT BOUNDARY VALUE METHOD Technical Summary Report
Gerardo A. Ache Oct. 1987 33 p
(Contract DAAL03-87-K-0028)
(AD-A193479; CMS-TSR-88-9) Avail: NTIS HC A03/MF A01 CSCL 20D

The decay rates are computed for stationary perturbations of Poiseuille flow in channels and pipes. The decay rates are found by solving eigenvalue problems of ordinary differential equations, where the eigenvalues give the rate of decay for the perturbation. A two-point boundary value method is used to compute the eigenvalues yielding efficient and accurate calculations. For the channel flow problem, the results are in agreement with previous calculations however, the problem of determining the rate of decay for a fluid motion in a pipe has not been considered before. For the Stokes problem in a pipe the eigenvalues, governing the rate of decay, are complex. Computations are carried out for small and moderate Reynolds numbers, also high Reynolds number computations were done to show the effectiveness of this method.
GRA

N88-29105# Wisconsin Univ., Madison. Center for Mathematical Sciences.
AN EXPONENTIAL DECAY ESTIMATE FOR THE STATIONARY PERTURBATION OF POISEUILLE FLOW Technical Summary Report
Gerardo A. Ache Oct. 1987 35 p
(Contract DAAL03-87-K-0028)
(AD-A193480; CMS-TSR-88-10) Avail: NTIS HC A03/MF A01 CSCL 20D

The author proves a decay estimate for the steady state incompressible Navier-Stokes equations. The estimate describes the exponential decay, in the axial direction of a semi-infinite tube, for an energy-type functional in terms of the perturbation of Poiseuille flow, provided that the Reynolds number does not exceed a critical value, for which we exhibit a lower and an upper bound. Since the motion is considered axi-symmetric we use a stream function formulation, and the results are similar to those obtained by Horgan for a two-dimensional channel flow problem. For the Stokes problem our estimate for the rate of decay is a lower bound to the actual rate of decay which is obtained from an asymptotic solution to the Stokes equations.
GRA

N88-29106*# Nevada Univ., Reno. Engineering Research and Development Center.
NUMERICAL INVESTIGATIONS IN THREE-DIMENSIONAL INTERNAL FLOWS Semiannual Status Report, 1 Oct. 1987 - 31 Mar. 1988
William C. Rose 15 Aug. 1988 13 p
(Contract NCC2-507)
(NASA-CR-183108; NAS 1.26:183108) Avail: NTIS HC A03/MF A01 CSCL 20D

An investigation into the use of computational fluid dynamics (CFD) was performed to examine the expected heat transfer rates that will occur within the NASA-Ames 100 megawatt arc heater nozzle. This nozzle was tentatively designed and identified to provide research for a directly connected combustion experiment specifically related to the National Aerospace Plane Program (NASP) aircraft, and is expected to simulate the flow field entering the combustor section. It was found that extremely fine grids, that is very small mesh spacing near the wall, are required to accurately model the heat transfer process and, in fact, must contain a point within the laminar sublayer if results are to be taken directly from a numerical simulation code. In the present study, an alternative to this very fine mesh and its attendant increase in computational time was invoked and is based on a wall-function method. It was shown that solutions could be obtained that give accurate indications of surface heat transfer rate throughout the nozzle in approximately 1/100 of the computer time required to do the simulation directly without the use of the wall-function implementation. Finally, a maximum heating value in the throat region of the proposed slit nozzle for the 100 megawatt arc heater was shown to be approximately 6 MW per square meter.
Author

N88-29107# Argonne National Lab., Ill.
STABILITY CONTROL OF LEAKAGE FLOW CHANNELS
T. M. Mulcahy, J. B. Grotberg, A. Prince, and E. L. Reiss 1988 8 p Presented at the 6th Symposium on Energy Science, Argonne, Ill., 4 May 1988 Prepared in cooperation with Northwestern Univ., Evanston, Ill.
(Contract W-31-109-eng-38)
(DE88-009995; CONF-8805106-1) Avail: NTIS HC A02/MF A01

Conditions for self-excited vibrations of channels conveying leakage flows are identified, including experimental results for an unconstricted slip joint. Several simple mathematical models of the interaction of the elastic channels and the flow are described, which should be useful for the identification and control of the structural instabilities.
DOE

N88-29108 Michigan State Univ., East Lansing.
ESTIMATION OF TRANSIENT HEAT TRANSFER COEFFICIENTS IN MULTIDIMENSIONAL PROBLEMS BY USING INVERSE HEAT TRANSFER METHODS Ph.D. Thesis
Arafa Mohamed Osman 1987 195 p
Avail: Univ. Microfilms Order No. DA8801855

The inverse heat transfer problem is one of considerable practical interest in the analysis and design of experimental heat transfer investigations. The analytical and experimental investigation of the inverse heat transfer coefficients in multi-dimensional convective heat transfer applications is examined. An application considered is the sudden quenching of a hot solid in a cold liquid. Other applications include thermal analysis of forced convection over impulsively started solid bodies and investigation of short duration wind tunnel experiments. The primary aim is to describe methods and algorithms for the solution of the ill-posed inverse heat transfer coefficient problem. The solution method used is an extension of the sequential future-information

method of Beck. Numerical experiments are conducted for a systematic investigation of the developed algorithms on selected heat transfer coefficient test cases. The overall objective of the experimental work is to investigate the early transients in the heat transfer coefficients from spheres in one- and two-dimensional quenching experiments. Several experiments were performed by plunging hollow spheres in either ethylene glycol or water. The developed methods are used for the analysis of the quenching experiments for the estimation of the transient heat transfer coefficients. Analysis of the results indicate that the transient inverse technique has the capability of estimating early transients and subsequent quasi-steady state values of the heat transfer coefficients in a single transient experiment. Dissert. Abstr.

N88-29109 Edinburgh Univ. (Scotland).
A NUMERICAL STUDY OF TURBULENT PLANE JETS IN STILL AND FLOWING ENVIRONMENTS EMPLOYING TWO-EQUATION k-EPSILON MODEL Ph.D. Thesis
S. K. Ali Al-hussyni 1987 314 p
Avail: Univ. Microfilms Order No. BRD-80451

A comprehensive review for modeling the round turbulent jet issuing normally into a crossflow was presented. The bulk of the thesis is concerned with the numerical solution for two flow situations: a plane turbulent, non-buoyant jet issuing normally into still surroundings and into a crossflow. The Reynolds stresses in the time-averaged momentum equations are calculated by a two-equation kappa-epsilon model in which differential equations are solved for the kinetic energy of turbulence and for the rate of dissipation. Dissert. Abstr.

N88-29110# Scientific Research Associates, Inc., Glastonbury, Conn.
AN EFFICIENT PATCHED GRID NAVIER-STOKES SOLUTION FOR MULTIPLE BODIES, PHASE 1 Final Report No. 1
Y. T. Chan and Bernard C. Weinberg 3 Feb. 1988 32 p
(Contract DAAL03-87-C-0010)
(AD-A194166; SRA-R88-930015-F; ARO-25053.1-EG-SBI) Avail: NTIS HC A03/MF A01 CSCL 12A

A major problem area in current computational fluid dynamics technology concerns flows about complex configurations formed by multiple components in relative motion. Major difficulties encountered in such problems are those associated with the grid. For such applications, the geometric constraints of the component elements often require that patched grids be employed. Herein, a novel and efficient procedure is described to solve the time-dependent, multidimensional Navier-Stokes equations about multiple body configurations. In contrast to existing patched grid approaches, the present method calculates the entire flow field over both grids simultaneously, without iteration. By eliminating iteration within a time step and allowing time steps to be chosen by accuracy considerations, rather than by stability limits, this procedure could lead to a substantial savings in computer run time. In addition, for steady state problems improved convergence rates could be expected. To demonstrate the capabilities and advantages of the new procedure, a problem of current interest in turbomachinery, the flow field in a rotor-stator stage, is investigated using the developed procedure. A steady state flow field about a cascade of displaced tandem Joukowski airfoils is considered. The accuracy of the calculations and CPT time used are compared with a calculation using a continuous deformed grid algorithm and a patched grid with iteration. GRA

N88-29111# Naval Postgraduate School, Monterey, Calif.
FLOW VISUALIZATION BY LASER SHEET M.S. Thesis
Joseph S. Chlebanowski, Jr. Mar. 1988 33 p
(AD-A194481) Avail: NTIS HC A03/MF A01 CSCL 14B

A flow visualization system using smoke and a laser sheet for illumination has been designed and developed for use in the 32- x 45-inch low speed wind tunnel. Major design features include a portable smoke rake designed for ease of installation and removal, the use of fiber optics to transport the laser light in a safe and convenient manner, and a portable traversing mechanism to traverse and orient the laser light sheet. The capabilities of the flow visualization system have been demonstrated by producing qualitative photographic recordings of complex flow patterns past an airfoil model and a missile model. GRA

N88-29112# Naval Postgraduate School, Monterey, Calif.
A MAPPING OF THE VISCOUS FLOW BEHAVIOR IN A CONTROLLED DIFFUSION COMPRESSOR CASCADE USING LASER DOPPLER VELOCIMETRY AND PRELIMINARY EVALUATION OF CODES FOR THE PREDICTION OF STALL Ph.D. Thesis
Yekutiel Elazar Mar. 1988 252 p
(AD-A194490; NPS67-88-001) Avail: NTIS HC A12/MF A01 CSCL 20D

Detailed measurements were made at M=0.25 and Re sub c = 700,000 of the flow through a linear compressor cascade of controlled diffusion (CD) blading using a two-component argon-ion laser Doppler velocimeter system. The measurements included mapping of the inviscid flow in the passage between two adjacent blades, boundary layer surveys, and wake surveys. Viscous flow phenomena such as a laminar separation region with reattachment on the suction surface, and laminar to turbulent transition on the pressure surface were resolved, and the viscous growth to the trailing edge was defined for three inlet angles from design incidence to near stall. Numerical calculations to predict the flow were carried out using a fully developed boundary layer code, a strongly interactive viscous inviscid code and a Navier Stokes code. It was shown that the common weakness of numerical predictors was in the modelling of transition and turbulence. The documented data can be used generally to calibrate compressor cascade analysis codes and thus enable reliable predictions of stall. GRA

N88-29113# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
COUPLING BETWEEN RADIATION AND GAS DYNAMICS Annual Report, 1 Feb. 1987 - 1 Feb. 1988
Charles L. Merkle and Michael M. Micci 1 Mar. 1988 52 p
(Grant AF-AFOSR-0048-84)
(AD-A194593; AFOSR-88-0448TR) Avail: NTIS HC A04/MF A01 CSCL 20D

Direct heat addition of flowing gases by radiation absorption is considered. In the visible wavelength regime, the interaction between concentrated solar energy and a flowing gas is being modeled numerically. Additional analyses of laser-gasdynamic interactions are also being considered. Implicit time-iterative procedures originally developed for transonic flows are being adapted to the low Mach number, low Reynolds number regimes of interest. Two-dimensional solutions show that absorption plasmas can exist over a wide range of flow speeds and that buoyancy is a dominant factor in the forced convection flowfields. In the microwave regime, an experimental investigation of various absorption modes is underway. An overview of the microwave resonant cavity experiment and initial experimental results with nitrogen is presented. Numerical predictions of the planar and propagation plasma mode of microwave absorption in hydrogen, helium and nitrogen are also discussed. GRA

N88-29114# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
DIRECT-SOLUTION TECHNIQUES FOR VISCOUS FLOWS AND THEIR CONTROL Annual Report, 15 Oct. 1986 - 14 Oct. 1987
Kirti N. Ghia and Urmila Ghia Jan. 1988 40 p
(Grant AF-AFOSR-0074-87)
(AD-A194775; AFL-88-1-73; AFOSR-88-0463TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Two main areas of research were pursued. In the area of active control of separated flows, the oscillating flap mechanism is examined by considering a backstep channel with an oscillating flap located in the primary reattachment region. A procedure has been developed for generating clustered conformal coordinates for this geometry with arbitrary orientations of the flap. Considerable effort was directed towards making the computational procedure efficient, so as to make it useful for repeated application needed

for this temporally deforming geometry. The corresponding flow solution is presently being developed. Flow past an elliptic cylinder is studied with the objective of examining flow control via an unsteady free stream. GRA

N88-29115*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
ADAPTIVE COMPUTATIONAL METHODS FOR AEROTHERMAL HEATING ANALYSIS Final Contractor Report, Sep. 1984 - Dec. 1987
John M. Price and J. Tinsley Oden May 1988 227 p Prepared in cooperation with Computational Mechanics Co., Austin, Tex.
(Contract NAS1-17894)
(NASA-CR-181636; NAS 1.26:181636; LMSC-HEC-TR-F225772)
Avail: NTIS HC A11/MF A01 CSCL 20D

The development of adaptive gridding techniques for finite-element analysis of fluid dynamics equations is described. The developmental work was done with the Euler equations with concentration on shock and inviscid flow field capturing. Ultimately this methodology is to be applied to a viscous analysis for the purpose of predicting accurate aerothermal loads on complex shapes subjected to high speed flow environments. The development of local error estimate strategies as a basis for refinement strategies is discussed, as well as the refinement strategies themselves. The application of the strategies to triangular elements and a finite-element flux-corrected-transport numerical scheme are presented. The implementation of these strategies in the GIM/PAGE code for 2-D and 3-D applications is documented and demonstrated. Author

N88-29116*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
NAVIER-STOKES CALCULATIONS OF TRANSONIC FLOWS PAST CAVITIES Final Report, 16 Jan. - 31 Aug. 1988
Oktay Baysal Sep. 1988 25 p
(Contract NCC1-121)
(NASA-CR-180484; NAS 1.26:180484) Avail: NTIS HC A03/MF A01 CSCL 20D

A computational investigation of subsonic and transonic flows past three dimensional deep and transitional cavities is presented. Computational simulations of these self induced oscillatory flows were generated through time accurate solutions of the Reynolds averaged full Navier-Stokes equations, using the explicit MacCormack scheme. The Reynolds stresses were included through the Baldwin-Lomax algebraic turbulence model with certain modifications. Two cases were computed to demonstrate the capability of the numerical scheme in modeling the complex three dimensional flow features inside a cavity. The results from an experimental investigation were used not only to benchmark the computations, but also to widen the database used for the discussions and conclusions. The computational results include instantaneous and time averaged flow properties everywhere in the computational zone. Time series analyses were performed for the instantaneous pressure values on the cavity floor. The features of deep and transitional cavity flows, and the effects of the sidewall on the cavity flow flowfield are illustrated through computational graphics. Author

N88-29117# Pittsburgh Univ., Pa. Dept. of Mathematics and Statistics.
VORTEX DYNAMICS OF COHERENT AND CHAOTIC STRUCTURES (INCLUDING ALGORITHMS FOR COMPUTER SIMULATIONS AND DIAGNOSIS) Final Report, 1 Sep. 1984 - 31 Aug. 1987
N. J. Zabusky 20 Dec. 1987 5 p
(Contract DAAG29-84-K-0149)
(AD-A193580; ARO-21371.14-MA) Avail: NTIS HC A02/MF A01 CSCL 20D

Substantial contributions have been made to understanding fundamental processes in two-dimensional inviscid and nearly dissipationless vortex dynamics through an approach called complementary modeling. We have identified and studied physical-space processes like merger, binding, axisymmetrization- and gradient-intensification of near-isolated regions of vorticity. We have employed a variety of algorithms and codes including pseudospectral, contour dynamical, and our recently introduced moment model. Through the last application, we have solved analytically an asymptotical representation of the symmetric merger problem and provided causes and conditions for merger that agree with pseudospectral and contour dynamical simulations. We have also delineated the essential parameters which control the final state of two nonidentical nearby vortices (asymmetric merger). GRA

N88-29118# Pennsylvania State Univ., University Park. Applied Research Lab.
A MULTIPLE-SCALES PARTIAL SOLUTION OF THE PULSE-FORCED RAYLEIGH-PLESSET EQUATION OF CAVITATION BUBBLE DYNAMICS
B. B. Baker and B. R. Parkin Feb. 1988 165 p
(Contract N00014-85-C-6041)
(AD-A193733; ARL/PSU/TR-88-002) Avail: NTIS HC A08/MF A01 CSCL 20D

A partial multiple scales analysis of the forced Rayleigh-Plesset equation of cavitation bubble dynamics is performed. Previous studies of cavitation inception on hemispherical headforms have revealed the existence of bubble ring cavitation on hemispherical headforms having a laminar separation region. Nuclei passing through the low pressure region that exists prior to the separation bubble experience vaporous growth which is characterized by two time scales. The forcing function pulse which acts on the nuclei is characterized by the laboratory time tau which varies slowly compared to the characteristic bubble time tau which characterizes the response time of a typical microscopic cavitation nucleus. GRA

N88-29119# Ballistic Research Labs., Aberdeen Proving Ground, Md.
COMPUTATIONAL FLUID DYNAMICS METHODS FOR LOW REYNOLDS NUMBER PRECESSING/SPINNING INCOMPRESSIBLE FLOWS
Michael J. Nusca Apr. 1988 30 p
(AD-A193891; BRL-MR-3657) Avail: NTIS HC A03/MF A01 CSCL 20D

Three dimensional, steady-state, laminar, fully viscous Navier-Stokes simulations were used to predict the behavior of incompressible liquids that were undergoing steady spin and steady precession at a fixed precession angle. These numerical simulations can predict steady viscous and pressure moments. These moments tend to increase the precession angle and reduce the spin rate of the container system. For a completely filled cylinder, liquid-induced roll and side (yaw) moments were computed as functions of cylinder height to diameter. GRA

N88-29120# International Centre for Theoretical Physics, Trieste (Italy).
NONEQUILIBRIUM FLOW OF A RADIATING GAS IN A VERTICAL CHANNEL WITH AXIAL TEMPERATURE VARIATION
A. R. Bestman May 1987 15 p
(DE88-702535; IC-87/100) Avail: NTIS (US Sales Only) HC A03/MF A01

Buoyancy induced flow of a vibrationally relaxing radiating gas in a vertical channel is studied for the case when one of the channel walls is cold while the other is hot. On the hot wall there is superimposed a small axial linear wall temperature variation. Perturbation expansions are developed for the solution and the basic problem which is nonlinear is integrated in a close form for an optically thin grey gas. The next approximation is linear and so is tackled by a fourth order Runge-Kutta method. Quantitative discussions of the solutions are presented. DOE

N88-29121# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Aerothermodynamique.
STUDY OF HYPERSONIC BOUNDARY LAYERS [ETUDE DES COUCHES LIMITES EN HYPERSONIQUE]
B. Aupoix and A. Lafon Jan. 1987 29 p In FRENCH
(Contract DRET-87-002-018)
(CERT-RSF-OA-17/5005-AYD; ETN-88-92889) Avail: NTIS HC A03/MF A01

The development of a three dimensional boundary layer computation procedure was continued in the frame of the studies of reentry vehicles of the Space Transportation System (STS) type. The main effort is to identify the factors affecting the flow patterns and to study the corresponding ionization phenomena. The computation procedure is enlarged with a method to solve unsteady the Navier-Stokes equation, necessary to treat the nose region. ESA

N88-29122# Stuttgart Univ. (West Germany). Fakultaet fuer Luft- und Raumfahrttechnik.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE STRUCTURE OF STATIONARY SHOCK WAVES IN GAS PARTICLE DISPERSIONS Ph.D. Thesis [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN UEBER DIE STRUKTUR VON STATIONAEREN VERDICHTUNGSSTOESSEN IN GAS-PARTIKEL-DISPERSIONEN]
Gerold Koenig 1987 132 p In GERMAN
(ETN-88-92983) Avail: NTIS HC A07/MF A01

Structure of stationary perpendicular shock waves in gas particle dispersions is investigated by theoretical and experimental comparison of shock profiles in the case of weak shock waves and small gas particles. Composition of polydispersions systems is studied by continuum theory taking in account particle size classes and interactions between particles and gas by pulse and energy exchange. Motion equations of dispersion systems consider thermal conductivity and friction in gas. In shock tubes laser beam extinction is used for particle concentration determination and laser differential interferometry is applied for gas density profile analysis. Shock profiles are measured in MgO smoke and SiO2 dust, for shock numbers 1.01 to 1.2. ESA

N88-29123# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
ROTATION SYMMETRIC INSIDE FLOW WITH DIAMETRIC EXPANSION RESOLUTION [ZUR RORATIONSSYMMETRISCHEN INNENSTROEMUNG MIT ABLOESUNG AN QUERSCHNITTSERWEITERUNGEN]
N. Weiser and W. Nitsche Mar. 1988 62 p In GERMAN
(Contract DFG-Ha-523/19-4)
(ILR-Mitt-193; ETN-88-93012) Avail: NTIS HC A04/MF A01

Flow physical relations between inlet conditions and the resulting flow profiles behind the diffusor surface are investigated on a test installation with laser light flow visualization. Reynolds numbers are varied between 5000 and 70,000, diffusor diameters between 50 to 80 mm by angles comprised between 6 and 90 deg. Velocity and pressure distributions are obtained by hot-wire and laser Doppler measurements. Mathematical models are presented for the two-dimensional axisymmetric stationary incompressible flow and the turbulent flow. Nonstationary measurements indicate time dependent relations for velocity, pressure, and temperature. ESA

N88-29124# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
MODELING OF LARGE STALL IN AXIAL COMPRESSORS [MODELISATION DU GRAND DECROCHAGE DANS LES COMPRESSEURS AXIAUX]
D. Buisine Feb. 1988 69 p In FRENCH
(VKI-NT-164; ETN-88-92720) Avail: NTIS HC A04/MF A01

A model to describe the behavior of large three-dimensional flow structures in stalled flow, e.g., return, stagnation, and centrifuge zones, is outlined. The interblade channels and spaces are modeled by macroelements which are sufficiently parameterized to take account of structures found in experimental studies. These elements, directed by equations for mass budget, amount of motion, and vorticity, are then assembled. Pressure was calculated by integration over the entire space constituted by the machine of the local elliptic system with respect to the boundary conditions for inflow and outflow. Only the first member operator was tested. Results are encouraging. ESA

N88-29125# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
APPLICATION OF PARTICLE IMAGE DISPLACEMENT VELOCIMETRY (PIDV) TO COMPLEX FLOWS: VELOCITY FIELD MEASUREMENTS IN FRONT OF A HEAVY GAS CLOUD
V. Gauthier and M. L. Riethmuller Mar. 1988 60 p
(VKI-TN-166; ETN-88-92721) Avail: NTIS HC A04/MF A01

The applicability of the particle image displacement velocity (PIDV) technique to the velocity field in front of clouds of heavy gases during instantaneous releases, to improve the understanding and modeling of air entrainment phenomena, was assessed. Time dependent features of the system and the implementation of a mirror to resolve the low velocity area and the direction ambiguity are described. The mixing areas in front are shown by determining the vorticity field. The motion of the air induced by the heavy gas flow is also considered. The velocity field during the impact of the front on a vertical wall is measured. Results demonstrate the applicability of PIDV to measurements in time-dependent conditions, and the possibility of this technique to determine the direction of the velocity vectors, thus resolving all the velocity range when an artificial velocity is superimposed using a mirror. The high resolution in measurements allows the determination of the vorticity field, and could also allow the local verification of the continuity equation if the concentration map, i.e., the local density was measured. ESA

N88-29126# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
A CALCULATION OF THE TURBULENT BOUNDARY LAYER ON A SLENDER ELLIPSOID AT LOW INCIDENCE
D. A. Humphreys 18 Apr. 1988 46 p Presented at the AGARD WG10 Meeting, Lisbon, Portugal, 28-29 Apr. 1988
(Contract FFA-FMV-F-K-AU-2828)
(FFA-TN-1988-02; ETN-88-92807) Avail: NTIS HC A03/MF A01

A calculation method for three-dimensional turbulent boundary layers was applied to the high Reynolds number air flow about a 6:1 ellipsoid at 10 deg incidence, and compared with wind tunnel results. The measured flow is very eventful over the lee side of the body, but an appropriately detailed description of the inviscid boundary conditions was not available. The calculations nevertheless reproduce the main character of the flow quite well. ESA

N88-29127# Societe Nationale Industrielle Aerospatiale, Cannes (France).
THE HEAT PIPE NETWORK OF TDF-1/TV-SAT. REVIEW OF THE DEVELOPMENT AT COMPLETION
M. Amdieu, S. Aucel, R. Giovannini, and B. Moschetti 25 Mar. 1988 8 p
(SNIAS-881-440-103; ETN-88-92873) Avail: NTIS HC A02/MF A01

A heat pipe network composed of 86 constant conductance heat pipes of different diameters and arranged along the 3 axes was developed to handle the 2.3 kW heat laod generated by the TDF satellites (1.3 kW dissipated inside the satellite). A test program involving more and more complex elements allowed the clarification of each of the problem areas related to the heat pipe design, such as ground testing representativity for 0g predictions, thermal contact between highly dissipative units and heat pipes, and integrity of junctions under mechanical stress. The tests enabled the validation of the heat pipe junction technology and showed the need for special care for on-ground testing as well as the influence of gravity on heat pipe performances. The elementary test results followed by the overall thermal tests on communication

module structure and thermal module, and protoflight models led to a great confidence in in-orbit temperatures predicted just before flight. The concept fulfills the thermal control requirements with a good margin. ESA

N88-29128# Societe Nationale Industrielle Aerospatiale, Cannes (France).
DEVELOPMENT OF A SPACE DEPLOYABLE RADIATOR USING HEAT PIPES
M. Amdieu, B. Moschetti, and M. B. Tatry (Centre National d'Etudes Spatiales, Toulouse, France) 25 Mar. 1988 7 p
(SNIAS-881-440-104; ETN-88-92874) Avail: NTIS HC A02/MF A01

A space radiator using heat pipes prototype model with a deployable radiator connected to a rotating thermal joint was designed, built, and tested. Performance tests were conducted on the model to measure deployment torque, and verifiy the thermal performance (globally and for each of the components). The good results of these tests show that this radiator can be adapted to all kinds of satellites and space platforms. ESA

N88-29129# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Research Center Aerodynamische Versuchsanstalt.
EUROPEAN RESEARCH PROGRAM ON VISCOUS FLOWS Annual Report, 1987
W. Kordulla, ed., J. Cousteix, ed., D. Humphreys, ed., J. Lindhout, ed., and P. D. Smith, ed. Dec. 1987 207 p
(DFVLR-AVA-IB-227-87-A-15; ETN-88-92970) Avail: NTIS HC A10/MF A01

Transition and reversed transition; structure of turbulent flows; wall flows; free and trailing edge flows; separation, reattachment, and shock/boundary layer interaction; unsteady flows and fluid dynamic noise; heat and mass transfer and multicomponent flows; experimental techniques; computational methods for viscous flows; and programs and subroutines are discussed. ESA

N88-29130# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
THE INFLUENCE OF DELAY EFFECTS ON THE DECAY OF LIQUID JETS Thesis [DER EINFLUSS VON LAUFZEIT-EFFEKTEN AUF DEN ZERFALL VON FLUESSIGKEITSSTRAHLEN]
A. H. Kloepper Nov. 1987 61 p In GERMAN
(MPIS-14/1987; ISSN-0436-1199; ETN-88-92976) Avail: NTIS HC A04/MF A01; Max-Planck-Institut fuer Stroemungsforschung, Boettinger Strasse 6-8, 3400 Goettingen, Federal Republic of Germany 23 deutsche marks

The influence of delay effects on fluid jets was investigated using velocity modulated free jets. The theoretical fundamentals of two models for the calculation of fluid jets are presented. A nozzle chamber was developed allowing the precise definition of velocity perturbations, and the measurement of the growth rates of the perturbations and of the stability limits. The measured growth rates are not well described by the linear theory. On the contrary, predictions of the delay theory are fully confirmed by the experiments. The limitations of both theories are discussed. ESA

N88-29131# Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
MODELING OF MOMENTUM TRANSPORT OF AXIALLY PARALLEL TURBULENT FLOWS IN ROD CASCADES Ph.D. Thesis [MODELLIERUNG DES IMPULSTRANSPORTES ACHSPARALLELER TURBULENTER STROEMUNGEN IN STABGITTERN]
Neele Neelen 1986 175 p In GERMAN
(ETN-88-92978) Avail: NTIS HC A08/MF A01

Problems and boundary conditions of the turbulent flow in heat exchangers, especially for nuclear fuel elements, are treated using mathematical models. Rod cascade flow and the physical fundamentals of turbulent flows are introduced. It is shown that the momentum transport phenomena can be separated into the radial and azimuthal directions. The geometrical characteristics of rod bundle geometries and a regression analysis are considered. The correlation coefficients for the wall parallel vortex viscosity are determined using a numerical optimization method. The order of magnitude of the secondary flow occurring perpendicularly to the main flow direction are determined to be 1 pct to 2 pct of the average axial velocity. The results obtained with the code VELASCO-BS are superior to those of previous codes. The azimuthal vortex viscosity is the decisive parameter, and secondary flow is not important for wall parallel momentum transport. ESA

N88-29132* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HIGH EFFECTIVENESS CONTOUR MATCHING CONTACT HEAT EXCHANGER Patent
Robert L. Blakely, inventor (to NASA), George J. Roebelen, Jr., inventor (to NASA), and Arthur K. Davenport, inventor (to NASA) (United Technologies Research Center, East Hartford, Conn.) 9 Aug. 1988 6 p Filed 19 Dec. 1986 Supersedes N87-18779 (25 - 11, p 1476)
(NASA-Case-MSC-20840-1; US-Patent-4,762,173; US-Patent-Appl-SN-943346; US-Patent-Class-165-170; US-Patent-Class-165-81) Avail: US Patent and Trademark Office CSCL 20D

There is a need in the art for a heat exchanger design having a flexible core providing contour matching capabilities, which compensates for manufacturing tolerance and distortion buildups, and which accordingly furnishes a relatively uniform thermal contact conductance between the core and external heat sources under essentially all operating conditions. The core of the heat exchanger comprises a top plate and a bottom plate, each having alternate rows of pins attached. Each of the pins fits into corresponding tight-fitting recesses in the opposite plate.
Official Gazette of the U.S. Patent and Trademark Office

N88-29133* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POLYMERIC HEAT PIPE WICK Patent
Benjamin Seidenberg 23 Aug. 1988 7 p
(NASA-Case-GSC-13019-1; US-Patent-4,765,396; US-Patent-Appl-SN-942158; US-Patent-Class-165-104.26; US-Patent-Class-138-38; US-Patent-Class-122-366; US-Patent-Class-165-905) Avail: US Patent and Trademark Office CSCL 20D

A wick for use in a capillary loop pump heat pipe is described. The wick material is an essentially uniformly porous, permeable, open-cell, polyethylene thermoplastic foam having an ultrahigh average molecular weight of from approximately 1 to 5 million, and an average pore size of about 10 to 12 microns. A representative material having these characteristics is POREX UF, which has an average molecular weight of about 3 million. This material is fully compatible with the FREONs and anhydrous ammonia and allows for the use of these very efficient working fluids in capillary loops.
Official Gazette of the U.S. Patent and Trademark Office

N88-29134*# National Aeronautics and Space Administration, Washington, D.C.
SHOCK WAVES IN UNSTEADY FLOWS
Gerard Tavera and Henri Burnage Sep. 1988 7 p Transl. into ENGLISH from Sur les Ondes de Choc Dans les Ecoulements Instationnaires, Academie des Sciences (Paris, France), Comptes Rendus, Serie A-Sciences Mathematiques, v. 284, no. 10, 7 Mar. 1977 p 571-573 Original language document was announced in IAA as A77-29597 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20329; NAS 1.77:20329) Avail: NTIS HC A02/MF A01 CSCL 20D

The space-time motion of a shock wave in an unsteady flow is taken into account by a kinematic description. The space is divided into an upstream and a downstream region, and the shock is replaced by an equivalent distribution of mass, momentum, and energy sources, all expressed as functions of the upstream

quantities and the motion of the shock. The result can be seen as an application of Huygens principle to the problem of the interaction between a shock wave and an unsteady flow. Author

N88-29135*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF EXPERIMENTAL TECHNIQUE OF OIL FLOW WITH EMPHASIS ON QUANTITATIVE DETERMINATION OF THE FLOW POSITION PARAMETERS ON THE SURFACE
Chingfa Zheng Aug. 1988 15 p Transl. into ENGLISH from Acta Aerodynamica Sinica (Peoples Republic of China), v. 5, Dec. 1987 p 383-389 Original language document was announced in IAA as A88-24444 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document was prepared by China Aerodynamic Research and Development Center
(Contract NASw-4307)
(NASA-TT-20341; NAS 1.77:20341) Avail: NTIS HC A03/MF A01 CSCL 20D

This paper discusses the reliability of the flow pattern obtained with the surface oil flow technique in detail. It successfully introduces a mathematical method to determine the 3-D coordinates of a surface point based on a single photograph. The flow separation positions of the classical plate and blunt cone model were calculated. The results indicate that in most cases the surface oil flow technique can be applied not only as a qualitative but also a quantitative experimental technique. Author

N88-28872# British Aerospace Public Ltd. Co., Weybridge (England). Military Aircraft Div.
DEVELOPMENT AND ANALYSIS OF TURBULENT NON-EQUILIBRIUM BOUNDARY LAYERS
A. G. T. Cross *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 250-270 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28873# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
SHOCK BOUNDARY LAYER INTERACTION
E. Stanewsky *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 271-305 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28875# Calspan Field Services, Inc., Arnold AFS, Tenn.
VORTEX FLOWS
Edward M. Kraft *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 338-355 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28876# Middle East Technical Univ., Ankara (Turkey). Dept. of Aeronautical Engineering.
ENVIRONMENTAL EFFECTS ON TRANSITION AND BOUNDARY LAYER CHARACTERISTICS
C. Ciray *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 356-408 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

N88-28877# Calspan Field Services, Inc., Arnold AFS, Tenn.
BOUNDARY LAYER MANIPULATION
Edward M. Kraft *In* AGARD, Boundary Layer Simulation and Control in Wind Tunnels Apr. 1988 p 409-446 (For primary document see N88-28857 23-01)
Copyright Avail: NTIS HC A20/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N88-29136*# Quantex Corp., Rockville, Md.
LARGE AREA NUCLEAR PARTICLE DETECTORS USING ET MATERIALS
27 Aug. 1987 17 p
(Contract NAS5-30054)
(NASA-CR-180777; NAS 1.26:180777) Avail: NTIS HC A03/MF A01 CSCL 14B

The purpose of this SBIR Phase 1 feasibility effort was to demonstrate the usefulness of Quantex electron-trapping (ET) materials for spatial detection of nuclear particles over large areas. This demonstration entailed evaluating the prompt visible scintillation as nuclear particles impinged on films of ET materials, and subsequently detecting the nuclear particle impingement information pattern stored in the ET material, by means of the visible-wavelength luminescence produced by near-infrared interrogation. Readily useful levels of scintillation and luminescence outputs are demonstrated. Author

N88-29137# Denver Univ., Colo.
PLZT (LEAD-LATHANIUM-ZIRCONIUM-TITANIUM) ELECTRO-OPTIC PHOTOGRAPHIC SYSTEM Technical Report, 14 Jul. - 31 Jul. 1987
Larry L. Brown 31 Jul. 1987 51 p
(Contract DNA001-86-C-0138)
(AD-A193473; Rept-5-32935; DNA-TR-87-164) Avail: NTIS HC A04/MF A01 CSCL 14A

A Lead-Lanthanum-Zirconium-Titanium (PLZT) Electro-optic enhanced photographic system is developed for high speed photographic documentation of Thermal Radiation Sources (TRS)/High Explosive (H.E.) detonations. Operational design parameters of this system were to have a 6 f-stop dynamic range and pulse response of 100 micro-seconds or less. A prototype PLZT system was designed, fabricated and laboratory tested with a wide variety of dynamic light sources that had substantially different spectral characteristics and radiant output. The prototype system performed satisfactorily for this test series and consequently a semi-hardened unit was fabricated for field use. The field unit was successfully tested with rocket propellant burns that simulated light intensities within the camera/PLZT systems field of view (FOV). These test results provided the confidence that the system was ready for deployment to a large scale test site. The PLZT photographic system was fielded on Project MISTY PICTURE to record the total TRS burn at the 10 psi (69 Kpa) overpressure environment. Several pre-event TRS burns were recorded. These film records were analyzed and electronic adjustments made to optimize the dynamic range of the PLZT system. The PLZT system was subsequently tested on the MISTY PICTURE event. Film analysis of the event shows that the system performed over its 6 f-stop range, allowing one camera to record the total TRS burn.
GRA

N88-29138# California Univ., Berkeley. Lawrence Berkeley Lab.
REAL-TIME MEASUREMENTS OF THE SIZE FRACTIONATION OF AMBIENT BLACK CARBON AEROSOLS AT ELEVATED HUMIDITIES
A. D. A. Hansen and T. Novakov Apr. 1988 12 p Presented at the 3rd International Conference on Carbonaceous Particles in the Atmosphere, Berkeley, Calif., 5 Oct. 1987
(Contract DE-AC03-76SF-00098)
(DE88-010870; LBL-24891; CONF-871055-7) Avail: NTIS HC A03/MF A01

The aethalometer is an instrument that responds to the

concentration of aerosol black carbon in real time. Recent versions constructed at Lawerence Berkeley Laboratory (LBL) contain two or three channels that may be operated simultaneously. When preceded by size-segregating inlets of differing cut points, this configuration allows for a real-time determination of the size fractionation of the black carbon component of the aerosol. In field measurements at LBL, we studied the incorporation of black carbon into marine fog droplets by comparing the total concentration with the interstitial aerosol concentration measured downstream of an interception mesh of 1 micron cutpoint. The data show that up to 80 percent of the carbon may be occluded by droplets. In separate experiments during SCAQS program in southern California, a three-channel instrument, equipped with impactors, measured total, less than 1 micron, and less than .03 micron concentrations, and showed diurnal variations of size fractionation of the ambient carbonaceous aerosol. These results imply that a significant fraction of the aerosol black carbon particles may exhibit hygroscopic behavior. DOE

N88-29139# Polytechnic Univ., Farmingdale, N.Y. Research Inst.

WIDE BAND GYROTRON TRAVELING WAVE AMPLIFIER ANALYSIS Final Report, 15 Oct. 1985 - 29 Feb. 1988

A. Rekiouak and B. R. Cheo Dec. 1987 124 p

(Contract DAAG29-85-K-0258)

(AD-A194269; POLY-WRI-1531-88; ARO-23282.1-PH-A) Avail: NTIS HC A06/MF A01 CSCL 09A

Linear and nonlinear analyses on a gyrotron amplifier with a periodically disc-loaded cylindrical waveguide circuit are performed. The dispersion relation of the circuit allows for wideband interaction with a relativistic beam of moderate power (Vb = 60kV, Ib = 5A). Linear analysis of the interaction with the fundamental mode shows a gain of the order of 50-60dB/m over a bandwidth larger than 22 percent and a linear phase versus frequency characteristic. Nonlinear analysis predicts the following saturation characteristics: a 48kW peak output power at 5.3GHz with 16 percent efficiency. The saturation length of the tube is about 37cm. These results show that this device is competitive with conventional high power traveling wave devices in performance, and, being simpler in structure, also in cost. GRA

N88-29140# Army Engineer Topographic Labs., Fort Belvoir, Va.

DETERMINING VEHICLE MOTION FROM STEREO IMAGE SEQUENCES

Anne Werkheiser 21 Aug. 1987 6 p

(AD-A194371; ETL-R-140) Avail: NTIS HC A02/MF A01 CSCL 12I

Results are reported from a research project on three-dimensional motion analysis. The work is based on stereo image sequences of a military vehicle. The analysis depends on the segmentation of the image and the matching of features between the two images. Preliminary results are given for an extension of the work to object recognition. Extracted features and the calculated parameters of motion are incorporated into a symbolic matching system. Object recognition is performed by the symbolic inexact matching of a representation of the photographs with a database of prototypes. The use of control points to furnish ground truth is discussed. GRA

N88-29141# Arizona Univ., Tucson. Dept. of Chemistry.

MOLECULAR FLUORESCENCE MEASUREMENTS WITH A CHARGE-COUPLED DEVICE DETECTOR Technical Report No. 61

P. M. Epperson, R. D. Jalkian, and M. B. Denton 4 Feb. 1988 23 p

(Contract N00014-86-K-0316)

(AD-A194437) Avail: NTIS HC A03/MF A01 CSCL 14B

A novel fluorescence spectrometer is described using a two-dimensional charge-coupled device as the detector and a mercury pen lamp as the excitation source. The fluorescence spectra and intensity of anthracene in ethanol standards at concentrations ranging from 0.0001 to 10 to the minus 11th power M are shown. The limit of detection measured is 10 to the minus 12th power M, or 227 parts-per-quadrillion. The linear dynamic range obtained with this instrument is 6 orders of magnitude with excellent linearity using 10 second signal integration time. GRA

N88-29142*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPTICAL MEASUREMENT OF UNDUCTED FAN BLADE DEFLECTIONS

Anatole P. Kurkov 1988 14 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989

(NASA-TM-100966; E-4131-1; NAS 1.15:100966) Avail: NTIS HC A03/MF A01 CSCL 14B

A nonintrusive optical method for measuring unducted fan (or propeller) blade deflections is described and evaluated. The measurement does not depend on blade surface reflectivity. Deflection of a point at the leading edge and a point at the trailing edge in a plane nearly perpendicular to the pitch axis is obtained with a single light beam generated by a low-power, helium-neon laser. Quantitiative analyses are performed from taped signals on a digital computer. Averaging techniques are employed to reduce random errors. Measured static deflections from a series of high-speed wind tunnel tests of a counterrotating unducted fan model are compared with available, predicted deflections, which are also used to evaluate systematic errors. Author

N88-29143# New York Univ., New York.

SQUID (SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE) ARRAYS FOR SIMULTANEOUS MAGNETIC MEASUREMENTS: CALIBRATION AND SOURCE LOCALIZATION PERFORMANCE Report, Sep. 1986 - Feb. 1988

Lloyd Kaufman, Samuel J. Williamson, and P. Costa Ribeiro 29 Feb. 1988 26 p

(Contracts F49620-86-C-0131; F49620-85-K-0004)

(AD-A193815; AFOSR-88-0364TR) Avail: NTIS HC A03/MF A01 CSCL 20C

Recently developed small arrays of SQUID-based magnetic sensors can, if appropriately placed, locate the position of a confined biomagnetic source without moving the array. The authors present a technique with a relative accuracy of about 2 percent for calibrating such sensors having detection coils with the geometry of a second-order gradiometer. The effects of calibration error and magnetic noise on the accuracy of locating an equivalent current dipole source in the human brain are investigated for 5- and 7-sensor probes and for a pair of 7-sensor probes. With a noise level of 5 percent of peak signal, uncertainties of about 20 percent in source strength and depth for a 5-sensor probe are reduced to 8 percent for a pair of 7-sensor probes, and uncertainties of about 15 mm in lateral position are reduced to 1 mm, for the configuration considered. GRA

N88-29144# New Mexico Univ., Albuquerque. Inst. for Accelerator and Plasma Beam Technology.

BEAM OPTICS TEST STAND Final Report, Sep. 1983 - Dec. 1985

S. Humphries, Jr. and G. Hess Apr. 1988 76 p

(Contract F29601-83-K-0077)

(AD-A193901; AFWAL-TR-86-17) Avail: NTIS HC A05/MF A01 CSCL 14B

The design and construction of the Beam Optics Test Stand (BOTS) is presented. A variety of computer compatible diagnostics has been developed to facilitate experiments. Extensive theoretical work is presented leading to the identification of two potential methods to correct aberrations in magnetic optics: biased grid arrays and space charge corrected solenoidal lenses. A series of experiments is presented which demonstrates, for the first time, the feasibility of space charge corrected optics. GRA

N88-29145*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SKIN FRICTION BALANCE Patent Application

Tcheng Ping, inventor (to NASA) and Frank H. Supplee, Jr., inventor (to NASA) 23 Jun. 1988 21 p
(NASA-Case-LAR-13710-1; NAS 1.71:LAR-13710-1; US-Patent-Appl-SN-210487) Avail: NTIS HC A03/MF A01 CSCL 14B

A skin friction balance uses a parallel linkage mechanism to avoid inaccuracies in skin friction measurement attributable to off-center normal forces. The parallel linkage mechanism includes a stationary plate mounted in a cage, and an upper and lower movable plate which are linked to each other and to the stationary plate throught three vertical links. Flexure pivots are provided for pivotally connecting the links and the plates. A sensing element connected to the upper plate moves in response to skin friction, and the lower plate moves in the opposite direction of the upper plate. A force motor maintains a null position of the sensing element by exerting a restoring force in response to a signal generated by a linear variable differential transformer (LVDT). NASA

N88-29146# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
RESULTS OF THE USE OF AN AUTOMATED ELECTRICAL MEASURING INSTRUMENT CALIBRATION SYSTEM
Pierre Barbier 1988 9 p
(SNIAS-881-430-107; ETN-88-92855) Avail: NTIS HC A02/MF A01

A system for calibrating digital multimeter and stimulus generators was developed. Software was written for fully automated machines, nonautomated instruments with digital output, and entirely manual machines. The advantages in terms of calibration quality, productivity, and operator motivation are stressed. ESA

N88-29147# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
CONSTRUCTION OF A LASER DOPPLER ANEMOMETER AND ITS USE FOR THE TESTING OF A NOVEL PROBE FOR THE MEASUREMENT OF THE VARIATIONS OF THE LATERAL COMPONENT OF THE VORTEX VECTOR Thesis [AUFBAU EINES LASER-DOPPLER-ANEMOMETERS UND EINSATZ ZUR ERPROBUNG EINER NEUEN SONDE ZUR MESSUNG DER SCHWANKUNGEN DER LAENGSKOMPONENTE DES WIRBELVEKTORS]
Eduard Bawirzanski Oct. 1987 92 p In GERMAN
(MPIS-13/1987; ISSN-0436-1199; ETN-88-92975) Avail: NTIS HC A05/MF A01; Max-Planck-Institut fuer Stroemungsforschung, Boettinger Strasse 6-8, Goettingen, Federal Republic of Germany 28 deutsche marks

A vortex probe for the measurement of the variations of the lateral component of the vortex vector in a turbulent channel flow was tested. A laser Doppler anemometer setup was built for the contactless scanning of the motion of the probe. The turbulent flow channel, the vortex probe, and the data acquisition system are described. Statistical quantities such as effective value, skewness, and flatness factor of the variations were determined for several wall distances. The variations were also spectrally analyzed using a fast Fourier transform algorithm. It can be concluded that the vortex probe is a good indicator for the variations of the lateral component of the vortex vector in a turbulent channel flow. ESA

N88-29148 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
A STUDY OF THE NATIONAL PHYSICS LABORATORY MICRODOSIMETRY RESEARCH PROGRAMME IN COLLABORATION WITH THE UNIVERSITY OF LEEDS (UNITED KINGDOM)
H. G. Menzel (Saarland Univ., Saarbrucken, West Germany) Nov. 1987 20 p
(Contract NPL-196/0152-A23)
(NPL-RS(EXT)-93; ISSN-0143-7135; ETN-88-93142) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

A microdosimetric measurement program; development of a transportable ready-to-use measurement system (tissue-equivalent proportional counter, pulse height analysis, calibration procedures, neutron-photon discrimination, quality factors, statistical aspects, general experimental procedure); and field measurements are reviewed. ESA

N88-29149* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ICE DETECTOR Patent
Leonard M. Weinstein, inventor (to NASA) 23 Aug. 1988 9 p Continuation-in-part of US-Patent-Appl-SN 846429, filed 31 Mar. 1986, abandoned
(NASA-Case-LAR-13776-1; US-Patent-4,766,369; US-Patent-Appl-SN-054980; US-Patent-Class-324-61-R; US-Patent-Class-244-134-F; US-Patent-Class-340-580; US-Patent-Appl-SN-846429) Avail: US Patent and Trademark Office CSCL 14B

An ice detector is provided for the determination of the thickness of ice on the outer surface on an object (e.g., aircraft) independently of temperature or the composition of the ice. First capacitive gauge, second capacitive gauge, and temperature gauge are embedded in embedding material located within a hollowed out portion of the outer surface. This embedding material is flush with the outer surface to prevent undesirable drag. The first capacitive gauge, second capacitive gauge, and the temperature gauge are respectively connected to first capacitive measuring circuit, second capacitive measuring circuit, and temperature measuring circuit. The geometry of the first and second capacitive gauges is such that the ratio of the voltage outputs of the first and second capacitance measuring circuits is proportional to the thickness of ice, regardless of ice temperature or composition. This ratio is determined by offset and dividing circuit.
Official Gazette of the U.S. Patent and Trademark Office

N88-29150* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LIQUID THICKNESS GAUGE Patent
Leonard M. Weinstein, inventor (to NASA) 23 Aug. 1988 8 p Continuation-in-part of US-Patent-Appl-SN-890982, filed 30 Jul. 1986, abandoned, which is a continuation-in-part of US-Patent-Appl-SN-684186, filed 20 Dec. 1984, abandoned
(NASA-Case-LAR-13826-1; US-Patent-4,765,187; US-Patent-Appl-SN-102705; US-Patent-Class-73-304-R; US-Patent-Class-73-290-R; US-Patent-Appl-SN-890982; US-Patent-Appl-SN-684186) Avail: US Patent and Trademark Office CSCL 14B

A method and apparatus are developed to measure the thickness of a liquid on a surface independent of liquid conductivity. Two pairs of round, corrosion resistant wires are mounted in an insulating material such that the cross-sectional area of each wire is flush with and normal to the surface. The resistance between each pair of wires is measured using two ac resistance measuring circuits, in which the ratio of the outputs of the two resistance measuring circuits is indicative of the thickness of the liquid on the surface.
Official Gazette of the U.S. Patent and Trademark Office

N88-29151* National Aeronautics and Space Administration. Pasadena Office, Calif.
THERMOCOUPLE FOR HEATING AND COOLING OF MEMORY METAL ACTUATORS Patent
Charles Wood, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 23 Aug. 1988 7 p Filed 23 Jul. 1987 Supersedes N87-29799 (25 - 24, p 3315)
(NASA-Case-NPO-17068-1-CU; US-Patent-4,765,139; US-Patent-Appl-SN-076956; US-Patent-Class-60-527) Avail: US Patent and Trademark Office CSCL 14B

A semiconductor thermocouple unit is provided for heating and cooling memory metal actuators. The semiconductor thermocouple unit is mounted adjacent to a memory metal actuator and has a heat sink attached to it. A flexible thermally conductive element extends between the semiconductor thermocouple and the actuator and serves as a heat transfer medium during heating and cooling

operations.
Official Gazette of the U.S. Patent and Trademark Office

N88-29152*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF OPTICAL CORRELATION TECHNIQUES TO PARTICLE IMAGING VELOCIMETRY
Mark P. Wernet and Robert V. Edwards 1988 23 p Presented at the Conference on Sensors and Measurement Techniques for Aeronautical Applications, Atlanta, Ga., 7-9 Sep. 1988; sponsored in part by AIAA, NASA and AFWAL
(NASA-TM-101306; E-4297; NAS 1.15:101306) Avail: NTIS HC A03/MF A01 CSCL 14B

Pulsed laser sheet velocimetry yields nonintrusive measurements of velocity vectors across an extended 2-dimensional region of the flow field. The application of optical correlation techniques to the analysis of multiple exposure laser light sheet photographs can reduce and/or simplify the data reduction time and hardware. Here, Matched Spatial Filters (MSF) are used in a pattern recognition system. Usually MSFs are used to identify the assembly line parts. In this application, the MSFs are used to identify the iso-velocity vector contours in the flow. The patterns to be recognized are the recorded particle images in a pulsed laser light sheet photograph. Measurement of the direction of the partical image displacements between exposures yields the velocity vector. The particle image exposure sequence is designed such that the velocity vector direction is determined unambiguously. A global analysis technique is used in comparison to the more common particle tracking algorithms and Young's fringe analysis technique. Author

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics*.

N88-29153# Minnesota Mining and Mfg. Co., St. Paul. Electronic and Information Sector Lab.
BLUE-GREEN LASER DIODE RESEARCH PROGRAM Final Technical Progress Report, 1 Oct. 1985 - 31 Dec. 1987
J. E. Potts, H. A. Mar, and C. T. Walker Feb. 1988 92 p
(Contract N00014-85-C-0552)
(AD-A191980) Avail: NTIS HC A05/MF A01 CSCL 09C

This report presents the results of work during the final quarter of ONR contract No. N00014-85-C-0552 (July 1, 1987 to September 30, 1987) and during a three-month extension of the original twenty-four month program (October 1, 1987 to December 31, 1987). This report concludes with a Summary Report describing the highlights and major accomplishments under this contract during the period October 1, 1985 to December 31, 1987 in the following areas: (1) Growth of unintentionally-doped ZnSe epitaxial films by MBE on (100) GaAs substrates in order to fully characterize the material and to understand the effects of varying growth conditions on the resultant film properties; (2) Growth of unintentionally-doped ZnSe on alternate substrates (Ge, Si, Ge with Ge buffer layer, Si with Ge/ZnSe strained-layer superlattice buffer layer) in an attempt to reduce the deleterious effects caused by lattice mismatch between the substrate and the epilayer and/or possible autodoping by contaminants from the substrates which had been suspected to occur when using GaAs substrates; (3) p-doping of ZnSe films on (100) GaAs substrates; (4) Examination of the lasing properties of ZnSe films using electron-beam pumping; and (5) Studies of metal contacts on SnSe for Ohmic contacts and Schottky barriers. GRA

N88-29154# Geltech, Inc., Alachua, Fla.
DEVELOPMENT OF HIGH EFFICIENCY q-SWITCHED GLASS LASER VIA SOL-GEL PROCESSING Final Technical Report, 15 Aug. 1987 - 14 Feb. 1988
William V. Moreshead 14 Feb. 1988 26 p
(Contract F49620-87-C-0087)
(AD-A192301; AFOSR-88-0096TR) Avail: NTIS HC A03/MF A01 CSCL 09C

The sol-gel process is a logical choice for silica-based laser glasses, since it requires lower processing temperatures than traditional melt glass techniques, and allows good control of purity. This report describes attempts to prepare silica glasses containing neodymium or neodymium and erbium using sol-gel technology. A description of two different doping procedures is given, along with results. The materials produced were characterized and the spectral, thermal, and physical properties are reported. Fluorescence spectra and fluorescence lifetimes are given for three different materials prepared. GRA

N88-29155# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
LARGE APERTURE MULTI-DIMENSIONAL LASER RADAR TESTBED
David U. Fluckiger, Mark P. Boldue, and Lorraine A. Prior 11 Mar. 1988 43 p
(Contract F19628-85-C-0002)
(AD-A193447; FCT-5; ESD-TR-88-118) Avail: NTIS HC A03/MF A01 CSCL 17I

A 39 cm aperture multi-dimensional laser radar has been built and made operational. This sensor acquires pixel registered range, Doppler, 3 to 5 micrometer passive, and visible passive data. Range is digitized at 200 MHz for .75 m range resolution. Doppler is resolved to .5 mph with a SAW spectrum analyzer. Multi-dimensional images can be taken with an angular resolution of from 33 microrad to 1 millirad. Image size and data flow are controlled by a minicomputer. The technical details of this laser radar testbed are the subject of this report. GRA

N88-29156# Maryland Univ., College Park.
FREE ELECTRON LASERS WITH SMALL PERIOD WIGGLERS Progress Report, 15 Sep. 1987 - 14 Sep. 1988
V. L. Granatstein, T. M. Antonsen, Jr., J. H. Booske, W. W. Destler, I. D. Mayergoyz, and E. Ott Jun. 1988 38 p
(Contract DE-FG05-87ER-52147)
(DE88-011627; DOE/ER-52147/1) Avail: NTIS HC A03/MF A01

The focus of the overall program is to develop short period wiggler (SPW) free electron lasers (FELS) as an alternate source of high-average-power millimeter wave radiation for electron cyclotron resonance heating (ECRH) in advanced magnetic fusion experiments such as the Compact Ignition Torus. Research progress to date is summarized with details described. So far, all of our studies have provided evidence which supports the feasibility of the SPW FEL concept. This includes investigations of sheet beam propagation and stability, thermal stability of the RF cavity under CW operation, and nonlinear evolution of (en dash) and competition between (en dash) multiple axial modes. The eventual goal of our program is to develop a 1.0 MW, CW-compatible SPW FEL operating near one millimeter wavelength. The near term goals are to demonstrate proof-of-principle in a pulsed system (1.5 microsec pulse length) and to identify solutions to additional problems that a long pulse (i.e., 3 sec) or CW system might encounter. A new two year research program is proposed beginning in September, 1988. The culmination of this program will be the proof-of-principle experiment, which we propose will commence operation in the beginning of calendar year 1990. DOE

N88-29157# Sao Paulo Univ. (Brazil). Inst. de Fisica.
EFFECT OF A LASER FIELD IN THE ELECTRON INELASTIC SCATTERING INTO PLASMA FIELDS M.S. Thesis
D. Hirata 1986 90 p In PORTUGESE
(DE88-702295; INIS-BR-1031) Avail: NTIS HC A05/MF A01

A theory for calculating cross section of the electron inelastic scattering process by an atom immersed in plasma and submitted to intense laser field was developed. The electrostatic shielding of plasma was considered in electron-electron interaction bound as in the electron-nucleus interaction. The formalism was applied for the study of 1s-2s and 1s-2p transitions in the hydrogen atom. The effect of shielding is to diminish the cross sections, and the

effect of laser field is to promote the scattering for energies below the threshold of each transition. In the presence of lasers, the cross sections presents characteristic oscillations of multiphoton process. DOE

N88-29158# Rochester Univ., N. Y. Lab. for Laser Energetics.
LLE (LABORATORY FOR LASER ENERGETICS) REVIEW Quarterly Report, Oct. - Dec. 1987
J. Kelly, ed. 1987 60 p
(Contract DE-FC08-85DP-40200)
(DE88-008065; DOE/DP-40200/65-Vol-33) Avail: NTIS HC A04/MF A01

This volume of the LLE review, covering the period October to December 1987, contains descriptions of the implementation of distributed phase plates for improved irradiation uniformity and the implementation of a cryogenic target capability on the OMEGA facility. The section on advanced technology has reports on the design and optimization of recombination X-ray lasers and a near-infrared dichroic dye for use in both active and passive liquid-crystal devices. Finally, the activities of the National Laser Users Facility and the GDL and OMEGA laser facilities are summarized. The highlights of this issue are: (1) Distributed phase plated, implementation on OMEGA, have made the target-plane illumination uniformity insensitive to near-field phase and intensity errors that previously produced hot spots on target. (2) An integrated system for producing, positioning, protecting, and documenting microballoons containing a frozen DT layer was put into operation on the OMEGA target chamber. (3) Recent modeling results using a new, explicit nonlocal treatment of the Doppler-enhanced escape probability of the resonance radiation has shown short-pulse illumination and cylindrical expansion to be very important for producing net gain in carbon recombination X-ray lasers. (4) A near-infrared-absorbing, liquid-crystalline dye has been shown to exhibit dichroic behavior in nematic liquid-crystal hosts. This dye has superior optical absorbance in the 1 m wavelength region and excellent solubility in nematic hosts. These properties make this dye/host combination particularly interesting for device applications such as blocking filters, shutters, and modulators for the near infrared. DOE

N88-29159# National Bureau of Standards, Gaithersburg, Md.
THE NBS/NRL (NATIONAL BUREAU OF STANDARDS/NAVAL RESEARCH LABORATORY) FREE ELECTRON LASER FACILITY
S. Penner, R. Ayres, R. Cutler, P. Debenham, and B. C. Johnson 1987 26 p
(Contract N00014-87-F-0066)
(AD-A194214) Avail: NTIS HC A03/MF A01 CSCL 09C

A free electron laser is being developed whose electron beam source is the 185-MeV CW racetrack microtron (RTM) presently nearing completion. This accelerator is characterized by extremely good emittance epsilon sub n somewhat less than 10 micrometers and small energy spread delta gamma/gamma somewhat less than .0003 at full energy. A new photocathode injector operating on the 32nd subharmonic of the 2380-MHz RF frequency is being developed to increase the peak current to somewhat more than 2 A in 3-ps micropulses. Our wiggler design has 130 periods of lambda sub w = 28 mm with RMS wiggler parameter K somewhat less than 1. Three-dimensional calculations indicated that power gains of 10 to 30 percent per pass can be achieved for optical wavelengths in the range 200 nm to 10.0 micrometers. The design of the RTM and FEL is described. This FEL is intended for use in a broad program of research applications in biomedicine and materials science. GRA

N88-29160# National Bureau of Standards, Gaithersburg, Md.
ANALYSIS OF FREE ELECTRON LASER PERFORMANCE UTILIZING THE NATIONAL BUREAU OF STANDARDS CW MICROTRON
Cha-Mei Tang and Phillip Sprangle 1987 4 p Previously announced in IAA as A88-41728
(Contract N00014-87-F-0066)
(AD-A194217) Avail: NTIS HC A02/MF A01 CSCL 20G

The National Bureau of Standards' (NBS) CW racetrack microtron (RTM) will be utilized as a driver for a free electron laser (FEL) oscillator. The NBS RTM possesses many exceptional properties of value for the FEL: (1) CW operation, (2) energy from 20 to 185 MeV, (3) small energy spread and emittance, (4) excellent energy stability, and (5) high average power. The 1-D FEL gain formula predicts that the FEL would oscillate at the fundamental approximately from 0.25 micron to 10 micron when up-grading the peak current to equal to or greater than 2 A. In this paper, we present 3-D self-consistent numerical results including several realistic effects, such as emittance, betatron oscillations, diffraction and refraction. The results indicate that the design value of the transverse emittance is small enough that it does not degrade the FEL performance for intermediate to long wavelengths, and only slightly degrades the performance at the shortest wavelength under consideration. Due to the good emittance, the current density is high enough that focusing, or guiding, begins to manifest itself for wavelengths greater than 2.0 microns GRA

N88-29161# Institute for Defense Analyses, Alexandria, Va.
SOLID-STATE LASER RESEARCH REPORT: ENERGY TRANSFER IN NON-UNIFORM CODOPED CRYSTALS Final Report, Oct. 1986 - Oct. 1987
Stanley R. Rotman and Francis X. Hartmann Mar. 1988 65 p
(Contract MDA903-84-C-0031)
(AD-A194358; AD-E500961; IDA-M-405; IDA/HQ-87-32921)
Avail: NTIS HC A04/MF A01 CSCL 09C

We develop an analytical model describing energy transfer between microscopically correlated donor-acceptor pairs in solid-state laser materials. We re-examine experimental data for several laser systems; host properties promoting enhanced non-radiative energy transfer are discussed. The results of this more general model are compared to the standard Foerster-Dexter approach of randomly placed donors and acceptors. This work is of interest to controlling thermal gradients, achieving new laser frequencies and improving laser efficiency. GRA

N88-29162# Air Force Weapons Lab., Kirtland AFB, N. Mex.
PRELIMINARY STUDIES OF NF3+H2 PRODUCTION OF N2(A3 SIGMA(+)u) IN A SUPERSONIC FLOW Final Report, Jul. 1984 - Feb. 1986
Y. D. Jones, N. D. Founds, and N. R. Pchelkin Feb. 1988 29 p
(AD-A194479; AD-E500985; AFWL-TR-87-71) Avail: NTIS HC A03/MF A01 CSCL 09C

The Tetrafluorohydrazine has been used in reaction with Diatomic hydrogen and Deuterium to produce NF a1 Delta, NF b1 Sigma and N2 A3 Sigma(+)u. The N2F4 is shock sensitive and not commercially produced. Nitrogen trifluoride, NF3 has been used in HF lasers as a fuel. By operating a conventional HF laser combustor at lower temperatures and less fuel, this study was designed to investigate the use of NF3 as a replacement for N2F4 in NF a1 Delta and N2 A3 Sigma(+)u production. Both of these energy transfer agents are of interest in the area of chemical lasers as an energy pump for a suitable species such as IF or NO. The NF3 was not only used in the combustor and injected into the H2 stream, but was also injected directly into the flow field. GRA

N88-29163# Air Force Weapons Lab., Kirtland AFB, N. Mex.
N2(A3EPSILON u+) BY REACTION OF N2F4+H2 IN A SUPERSONIC FLOW Final Report, Jul. 1984 - Feb. 1986
Y. D. Jones, N. D. Founds, D. V. Hibson, and M. R. Palmer Mar. 1988 38 p
(AD-A194493; AFWL-TR-87-73) Avail: NTIS HC A03/MF A01 CSCL 09C

The tetrafluorohydrazine + diatomichydrogen deuterium reaction has been used to produce NF a1delta and NF b1sigma in supersonic flow. The extension of that reaction sequence in excess hydrogen is that diatomic nitrogen (B) is produced which relaxes to the N2(A) electronic state with an energy content of 6.2 eV. The energy storage potential of N2(A) and subsequent transfer of energy to other molecules, such as NO, SO and IF,

makes this production method of extreme interest for laser applications. The device diagnostics, parametric studies and final yield of N2(A) are described. The yield of N2(A) is lower than expected from subsonic studies, but the experiments indicate areas of study required to understand the system in greater detail.
GRA

N88-29164# Yale Univ., New Haven, Conn.
HIGH ENERGY AND HIGH INTENSITY LASER EFFECTS ON AEROSOLS: CHANGES IN DROPLET MORPHOLOGY, SURROUNDING TEMPERATURE AND VAPOR CONCENTRATION Final Report, 1 Feb. 1985 - 31 Jan. 1988
Richard K. Chang Mar. 1988 18 p
(Contract DAAG29-85-K-0063)
(AD-A193825; ARO-22517.21-GS) Avail: NTIS HC A03/MF A01 CSCL 07C

Nonlinear optical interactions in a droplet occur at remarkably low input intensity levels because the droplet acts as a lens to concentrate the input radiation at a location just within the shadow face and as an optical cavity to provide feedback for the internally generated radiation. LIB within the droplet occurs when the rising portion of the input laser pulse causes multiphoton ionization which is followed by cascade multiplication. The resultant plasma within the droplet transforms a nominally transparent droplet into an absorbing droplet, and the remaining portion of the input laser pulse heats the droplet. Multiple scattering calculations and measurements were made from two closely spaced fibers which served as a prototype of densely packed aerosols. The comparison between the exact calculation for two fibers and the experimental results from the fiber-mirror configuration was excellent and provided new insight into the multiple scattering from closely spaced aerosols.
GRA

N88-29165# Texas Univ., Dallas. Center for Quantum Electronics.
PROOF OF THE FEASIBILITY OF COHERENT AND INCOHERENT SCHEMES FOR PUMPING A GAMMA-RAY LASER Quaterly Technical Progress Report, 1 Oct. - 31 Dec. 1987
Carl B. Collins Jan. 1988 62 p
(Contract N00014-86-C-2488)
(AD-A193856; GRL/8703) Avail: NTIS HC A04/MF A01 CSCL 09C

Recent approaches to the problem of the gamma ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long wavelength radiation. At the nuclear level the storage of energy can approach tera-Joules per liter for thousands of years. This report focuses upon the nuclear analog of the optical double resonance methods which produced much of the database at the molecular level that was of such essential use in the development of conventional lasers. Applied most recently to the study of levels which might be used in dumping isomeric populations into freely radiating states, it produced an unexpected result of major importance. In several test isotopes, a class of extremely useful states was discovered that could radiatively couple to both normal and isomeric states of a nucleus spanning large changes of angular momentum. Achievements culminated in the demonstration of the dumping of population of the first candidate for a gamma-ray laser. One of the least attractive of the isomers because of a large change in angular momentum of 8 h-bar 180Ta superscript m was the only one of the candidates available in milligram quantities. Pumped with the bremsstrahlung from a medical linear accelerator having its maximum output near 2 MeV, and astonishingly large cross section of 40,000 was found on the scale where unity results in a large yield.
GRA

N88-29166# Laser Power Optics, San Diego, Calif.
MIDIR (MID-INFRARED) LASER, PHASE 1 Final Report, Aug. 1987 - Feb. 1988
Douglas Tanimoto, William Jeffers, and Jeffrey Shellan 15 Apr. 1988 54 p
(Contract DAAB07-87-C-F066)
(AD-A193935) Avail: NTIS HC A04/MF A01 CSCL 09C

Advances in sensor technology have led to a proliferation of electro-optical systems operating in the mid-infrared (3 to 5 micron). Examples are search and track sets, missile seekers, laser designators, and high energy lasers. To counter enemy use of such systems, jamming and collecting systems which employ lasers of modest power operating within the spectral pass-band of the threat are required. A modulated, wavelength agile, compact, mid-infrared laser of moderate average output powers is extremely attractive for infrared countermeasures and OPTINT collections applications. A unique electric discharge gain generator design has been investigated which promises significant improvements in efficiency, compactness and reliability for pulsed gas laser systems with high peak power and moderate average power outputs.
GRA

N88-29167# International Centre for Theoretical Physics, Trieste (Italy).
EVIDENCE FOR LASER EMISSION FROM THE TICT EXCIPLEX OF COUMARIN DYES
V. Masilamani Jun. 1987 10 p
(DE88-702544; IC-87/109) Avail: NTIS (US Sales Only) HC A02/MF A01

This paper gives confirming evidence for the possibility of super radiant laser emission from the Twisted Internal Charge Transfer (TICT) conformation in the excited state complex with a solvent of the coumarin family of laser dyes.
DOE

N88-29168# International Centre for Theoretical Physics, Trieste (Italy).
BREAKDOWN OF MOLECULAR OXYGEN BY BRIEF PULSES OF LASER RADIATION
Yosr. E. E-D. Gamal Aug. 1987 13 p Submitted for publication
(DE88-702687; IC-87/285) Avail: NTIS (US Sales Only) HC A03/MF A01

We report a numerical analysis for the combined action of multi-photon (MPHI) and Cascade Ionization (CI) processes in producing ionization and breakdown of molecular oxygen. The calculations were carried out at two different laser pulses of wavelengths 0.6943 and 0.53 microns with pulse durations 18ps and 25ps respectively, over a pressure range of 10 squared - 5 x 10 to the 4th Torr. A reasonably good agreement has been obtained between the computed threshold intensities and the measured ones. Computations for nitrogen irradiated with 0.53 microns are also given. This analysis shows that the model is capable to interpret gas breakdown experiments with short flashes of laser radiation.
DOE

N88-29169# European Space Agency, Paris (France).
MODELING OF PULSED GAS FLOW LASERS
Friedrich Offenhaeuser (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart, West Germany) Jun. 1988 143 p Transl. into ENGLISH of Modellierung von Gepulsten Gasstromungslasern, Stuttgart, Federal Rep. of West Germany (DFVLR) Original language document was announced as N88-17021 (ESA-TT-1090; DFVLR-FB-87-19; ETN-88-93052) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 50.50 deutsche marks

Very complex simulation problems, occurring in the description of pulsed gas flow lasers were modeled. The fundamentals of the laser model are described. The computer code has the property that the type of laser is specified by a data file only. Hence, the laser model can be applied without changes of the computer program to all gas flow lasers whereby gas flow, optical axis, and a possible electrical excitation act perpendicularly to each other.
ESA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-29170 Ohio State Univ., Columbus.
MOTION PLANNING FOR LEGGED LOCOMOTION SYSTEMS ON UNEVEN TERRAIN Ph.D. Thesis
Ramakrishnan Vijaykumar 1987 331 p
Avail: Univ. Microfilms Order No. DA8726744

Intelligence is an integral part of an autonomous mobile robot. The robot must have the ability to perceive an environment, recognize the redundancy in the available information, and the set of alternatives in any given situation. Further, it must be able to intelligently choose an alternative without human interference. The research described is an attempt to develop intelligent motion planning strategies for an autonomous legged vehicle. A hierarchical structure of intelligence with four levels is proposed. They are the planner or the route layout module, the navigator or the path selection module, the pilot or the guidance module, and the controller or the execution module. The wave gait was appropriately modified and optimized for omnidirectional, rough terrain locomotion. Appropriate support sites are selected by a foothold selection algorithm. An adaptive gait controller, which automatically adapts the gait to a constantly changing terrain and irregular foothold patterns, and a body motion regulation module, which controls the body attitude and altitude, were developed. A problem encountered in walking machines, and other actively coordinated mechanisms, is the static indeterminancy in the force distribution in closed loop kinematic chains. Several methods for resolving this redundancy using the terrain model were studied for application in active compliance control schemes, and for predicting vehicle stability. A computer simulation of the proposed algorithms for the Adaptive Suspension Vehicle, a six-legged vehicle, was also described. Dissert. Abstr.

N88-29171# Georgia-Pacific Corp., Toledo, Oreg. Paper Div.
REDUCTION IN MILL AIR COMPRESSOR POWER REQUIREMENTS THROUGH INSTALLATION OF A VARIABLE FREQUENCY SPEED CONTROL
Mar. 1988 67 p
(Contract DE-MS79-86BP-92222)
(DE88-008493; DOE/BP-92222/1) Avail: NTIS HC A04

A variable frequency drive system was installed to enable variable speed control of one of the mills 1000 hp rotary screw air compressors. Prior to this installation, control was achieved by a combination of recycling low pressure stage air, bleeding air to the atmosphere and bag plant and by loading and unloading the compressors. This method of control was costly in energy usage and in equipment wear and tear. This installation has eliminated the need to bleed off air and load and unload the compressors and has greatly reduced the recycle. It has resulted in a 20 percent savings in mill air compressor power usage (2.119 million kWh annually) and a 33 percent reduction in mill air pressure variation. The turndown on variable speed is limited by the intercooler pressure and at a minimum 53 percent speed is less than expected. Although the total energy saved is double the original projection due to an unexpected decrease in total air demand, only 77 percent of the projected savings were realized in the areas expected.
DOE

N88-29172# Mechanical Technology, Inc., Latham, N. Y.
DEVELOPMENT OF HIGH TEMPERATURE, HIGH PRESSURE ROTATING SHAFT SEALS Final Report
H. Heshmat and W. Shapiro Jun. 1987 211 p
(Contract DE-AC21-85MC-22074)
(DE88-001029; DOE/MC-22074/2533) Avail: NTIS HC A10/MF A01

Rotating shaft seals used in coal gasification equipment are exposed to difficult environmental conditions including temperature from 430 C to 816 C (800 F to 1500 F), high pressure (to 10 MPa or 1500 psig), and high levels of particulate contamination (50,000 to 100,000 ppM). The program reported upon was designed to develop long-life seals that would not require external flushing or cooling. The approach taken was to develop unbalanced face that would remain closed and prevent particulate entry into the interface. Wear resistant materials and coatings with low friction coefficients are required. Significant results of the program are enumerated: The selected material combination was a rotating runner of Kentanium K162B mating against a non-rotating seal ring of Kentanium K162B. Kentanium is the trade name of a series of hard carbide alloys with pure titanium carbide as the principal ingredient. Nickel and nickel molybdenum are used as binder materials. Kentanium retains most of its strength at temperatures up to 1100 C (2000 F). Since hard materials are required to resist wear and withstand the temperatures, mechanical compliance must be built into the seal configuration for the opposed faces to follow runner nutations and remain closed. Environmental and frictional heating caused the formation of very small particles of titanium oxide which lodged in the face wave formations and acted as an interfacial lubricant. The results of this program provide encouragement and optimism that dry contact face seals can be developed for long unattended operation in the hostile environment of a coal gasification plant.
DOE

N88-29173# Oak Ridge Gaseous Diffusion Plant, Tenn.
DEVELOPMENT OF THE SIMPLIFIED COMPRESSOR MODEL (SCM) FOR PERFORMANCE ANALYSIS OF GASEOUS DIFFUSION COMPRESSORS
S. T. Baker Oct. 1987 22 p
(Contract DE-AC05-84OT-21400)
(DE88-009066; K/QT-141) Avail: NTIS HC A03/MF A01

This report documents the progress on the FY 87 K-site Milestone (for the Process Equipment and System Performance (PESP) team of the Process and Long Range Technical Support (PandLRTS) program) which calls for the formulation of simplified compressor performance prediction codes for use in GDP cascade models. In particular, the features, benefits, steps in the development, and results of a simplified compressor model (referred to as the SCM) for predicting the off-design performance of compressors used in the gaseous diffusion process are discussed. Calculations for the T7 compressor were performed at 1700 hp and at discharge temperatures of 265 F, 290 F, and 315 F (these temperatures representing all temperatures at 1700 hp for which experimental data is available). The results of these calculations are shown in Figures 8 through 10. Note that the SCM does a much improved job in predicting the efficiency and A-stream volume flow rate than the larger, more complex code, DYNADEC. Agreement between test data and the SCM calculations for static pressure ratios and B-stream equivalent volume flow is comparable to that obtained by DYNADEC. Each set of four performance maps required approximately one minute of CPU on a VAX 8600 using the SCM (compared to nearly one hour of CPU using DYNADEC).
DOE

N88-29174# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
QUALIFICATION OF EXPANSION AND WELDING PROCEDURES OF TUBE-TO-TUBESHEET JOINTS FOR HEAT EXCHANGERS IN NUCLEAR POWER PLANTS
G. D. M. Camargo, J. G. V. Couto, and L. A. S. deCastro 1986 18 p In PORTUGUESE; ENGLISH summary Presented at the 4th Brazilian Symposium on Piping and Pressure Vessels, Salvador, Brazil, 28 Oct. 1986
(DE88-701621; INIS-BR-967; CONF-8610317) Avail: NTIS (US Sales Only) HC A03/MF A01

Leaking tube to tubesheet joints are among the most frequent defects detected in the operation of tubular heat exchangers. This kind of problem requires a special treatment, in the case of heat exchangers installed in nuclear power plants, aiming at a minimum of leakages and further repair outages. The criteria used for the prequalification of tube-to-tubesheet joints, is described, and the experiences acquired during the tests and fabrication of several components supplied by national manufacturers, are presented.
DOE

N88-29175 Cornell Univ., Ithaca, N.Y.
MOTION PLANNING WITH OBSTACLES AND DYNAMIC CONSTRAINTS Ph.D. Thesis
Sunil Kumar Singh 1988 171 p
Avail: Univ. Microfilms Order No. DA8804627

Robots must be capable of executing a variety of tasks precisely and under changing conditions. For this reason, it is not sufficient to have simple robot controllers which can be programmed to perform specific tasks. The concept of motion planning is a first step towards solving this problem. The planner is analogous to the brain of the human being in many respects. It accepts as inputs the nature of the task to be executed and the description of the environment and uses its knowledge of the capabilities of the manipulator to generate a sequence of commands to be executed by the controller. The primary objective was to design a planner which could be successfully integrated with the ordinary robot controllers. The aim was to produce not only the spatial path which the manipulator must track to avoid obstacles, but the actual control signals that could be fed to the motors driving the manipulator. The overall problem was posed as an optimal control problem with control and state variable inequality constraints. Computational issues such as discretization effects and algorithmic efficiency were investigated. The planner was implemented on the Unimate PUMA manipulator in simulations. The efficiency of the planner is directly related to its information on the response of the manipulator to inputs. To handle unexpected disturbances or modeling errors, an adaptive feedback controller, based on linearized manipulator dynamics along the planned trajectory, was designed. A recursive parameter identification scheme was used to identify the model and update the feedback gains.
Dissert. Abstr.

N88-29176# Sandia National Labs., Albuquerque, N. Mex.
STATIC AND DYNAMIC METAL-METAL FRICTION AT PLASTIC STRESS LEVELS
R. J. Bourcier and D. T. Schmale May 1988 19 p
(Contract DE-AC04-76DP-00789)
(DE88-011281; SAND-88-0880) Avail: NTIS HC A03/MF A01

A new test technique has been developed for adhesive metal/metal friction at high sliding rates and plastic stress levels. The test specimen consists of a thick walled metal tube and a tapered metal rod. The rod is pulled through the tube at rates up to approximately 10,000 mm/sec. The tubes plasticity can be varied by changing the tapered rod. Finite element simulations were used. Both the quasistatic code JAC and the dynamic wave propagation code PRONTO were used. Tests were performed using annealed OFHC copper tubes and cold worked 316 stainless steel rods. Two tests were performed at 1.67 mm/sec: one unlubricated, and one using Molybdenum Disulfide spray lubrication resulted in approximately a factor of two reduction of load. The third test was unlubricated at 7,440 mm/sec. This test yielded a maximum load one half that found in the unlubricated static test, indicating a rate dependence of the plastic friction coefficient. The finite element model was compared with the experiment. Results suggest that the unlubricated, static test yields a value mu = 0.4 while both the lubricated, static test, and the unlubricated, dynamic test result in mu = 0.2. This is consistent with those of previous workers and with features observed on the wear surfaces using scanning electron microscopy. DOE

N88-29177# Marine Imaging Systems, Inc., Pocasset, Mass.
REMOTELY OPERATED VEHICLE (ROV) RELIABILITY STUDY, PHASE 1 Final Report, Aug. - Dec. 1987
Kurt L. Smrcina and John P. Fish Dec. 1987 46 p
(Contract N00014-87-C-0728)
(AD-A194367; MIS-8712001) Avail: NTIS HC A03/MF A01
CSCL 13J

A Remotely Operated Vehicle (ROV) reliability study was initiated to determine how ROVs can be designed and built to achieve enhanced operational reliability when operated during extended underwater deployment. The contractor was to examine the technology used in the design and construction of representative ROVs which are currently state-of-the-art and document proposed design or construction methodology to effect high reliability. This study report is the result of the contractor's study efforts. The study result revealed that the process of development and procurement of ROVs for Navy use presently involves modification of off-the-shelf commercial vehicles. Long term reliability is not a design criteria for commercial vehicles and is certainly lost in the development process due to cost competition. As a result, commercial grade vehicles with broad applications are modified for specific requirements. These vehicles have reliability and other problems as described in detail in this report. Present state-of-the-art ROVs cannot be modified to meet the requirements for reliability of extended deployment vehicles. Development of a highly reliable long term deployment vehicle requires the rigorous use of a through development process.
GRA

N88-29178# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
TWO PHASE FLOW IN A ROTATING SCREW TUBE (SCREW TUBE PUMP). INVESTIGATION OF THE FUNCTION AND EFFICIENCY OF THE SCREW TUBE PUMP Thesis [ZWEIPHASENSTROEMUNG IN EINEM ROTIERENDEN WENDELROHR (WENDELROHRPUMPE). UNTERSUCHUNG ZUR FUNKTION UND LEISTUNGSFAEHIGKEIT DER WENDELROHRPUMPE]
H. ElHaffar Dec. 1987 61 p In GERMAN
(MPIS-16/1987; ISSN-0436-1199; ETN-88-92977) Avail: NTIS HC A04/MF A01; Max-Planck-Institut fuer Stroemungsforschung, Boettinger Strasse 6-8, Goettingen, Federal Republic of Germany 60 deutsche marks

The working principle of the screw tube pump is presented. The quasistatic theory of the screw tube pump is introduced. The mathematical model calculates static pressure in single windings. The experimental determination of the water flow on the test stand shows that water transport is optimum if the drum is half immersed. A horn-type collector cone at the water inlet side allows the pump to reach maximum efficiency even at low water level. ESA

N88-29179 British Petroleum Co. Ltd., London (England).
LEAF SPRING Patent Application
Kevin David Potter, inventor 20 Jan. 1988 4 p Filed 16 Jul. 1987 Priority 17 Jul. 1986 GB
(GB-Patent-2-192-689-A; GB-Patent-Appl-SN-8716748; Int-Patent-Class-F16F-1/26; ETN-88-93125) Avail: UK Patent Office, 25 Southampton Buildings, London WC2A 1AY, United Kingdom

A leaf spring suitable for use in a vehicle suspension system comprising a plurality of leaves, the end portions of adjacent leaves having means for engaging each other which allow relative longitudinal movement but restrain relative lateral movement, is presented. ESA

N88-29180* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
COLLET LOCK JOINT FOR SPACE STATION TRUSS Patent
Clarence J. Wesselski, inventor (to NASA) 16 Aug. 1988 13 p Filed 1 Apr. 1987 Supersedes N87-25576 (25 - 19, p 2615)
(NASA-Case-MSC-21207-1; US-Patent-4,763,459; US-Patent-Appl-SN-032818; US-Patent-Class-52-646; US-Patent-Class-52-648; US-Patent-Class-403-217; US-Patent-Class-403-171) Avail: US Patent and Trademark Office CSCL 13I

A lock joint for a Space Station has a series of struts joined together in a predetermined configuration by node point fittings. The fittings have removeable inserts. The lock joint has an elongated housing connected at one end to a strut. A split-fingered collet is mounted within the housing to insure reciprocal movement. A handle on the housing is connected to the collet for moving the collet into the insert where the fingers of the collet expand to lock the joint to the fitting.
Official Gazette of the U.S. Patent and Trademark Office

N88-29181* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PRELOADED BRAKE DISC Patent
William C. Schneider, inventor (to NASA), Kornel Nagy, inventor (to NASA), and Clarence J. Wesselski, inventor (to NASA) 16 Aug. 1988 8 p
(NASA-Case-MSC-21132-1; US-Patent-4,763,762; US-Patent-Appl-SN-118992; US-Patent-Class-188-218-XL; US-Patent-Class-188-251-A) Avail: US Patent and Trademark Office CSCL 13I

A disc brake system for a shuttle orbiter is described, which has an annular disc element with internally radially directed and angularly spaced relief slots and trapezoidal shaped carbon pad members arranged circumferentially around the disc element. T clips snugly engage the outer heads of the pad members and are attached to rivet heads, and have guide members which slide into guide grooves in a spring housing. Springs provide a force tending to move the T clips toward the center of the disc where the magnitude of the force can be adjusted by a screw.
Official Gazette of the U.S. Patent and Trademark Office

N88-29182*# National Aeronautics and Space Administration, Washington, D.C.
SURFACE PROPERTIES IN ELECTRIC DISCHARGE MACHINING
F. Roethel May 1988 18 p Transl. into ENGLISH from Strojniski Vestnik (Yugoslavia), v. 23, May - Jun. 1977 p 125-132 Original language document was announced in A77-44600
(Contract NASw-4307)
(NASA-TT-20243; NAS 1.77:20243) Avail: NTIS HC A03/MF A01 CSCL 13I

Research on electric discharge machining (EDM) parameters, workpiece surface variables, and flaw structure is summarized. Relations between crater diameter, crater depth, surface roughness, discharge current, ignition delay, discharge pulse width, discharge energy, metal removal rate, metal hardness, applied voltage and cooling rate are explored. The test arrangement and the steel grades tested are described. Types of flaws (inclusions, blisters, notches, porosity, microvoids and shrinkage cavities), crack depth, thermal conductivity, grain boundary diffusion, and succession of phases (retained austenite, hard martensite, soft martensite), and surface layers are dealt with. Author

N88-29183*# National Aeronautics and Space Administration, Washington, D.C.
STUDY ON DESIGN AND CONTROL OF TORQUE-CONTROLLED MANIPULATORS
Kunikatsu Takase Sep. 1988 176 p Transl. into ENGLISH of Electrotechnical Laboratory, Researches (Japan), no. 876, Dec. 1986 p 1-142 Original language document was announced in IAA as A87-49650 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20197; NAS 1.77:20197) Avail: NTIS HC A09/MF A01 CSCL 13I

Robot tasks are analyzed in general, and robot motions for executing these tasks are studied. Servo-implementation methods are developed for generalized robot motions, considering the dynamic properties of the controlled system. Individual topics addressed include: (1) the representation of motions as the interactions of position, velocity, and force in a task-coordinate system; (2) the control of motions represented in the task coordinates; (3) the structural teaching of position and orientation in the task coordinates; and (4) the design and development of torque-controlled manipulator that can exert force accurately.
Author

N88-29184*# Battelle Columbus Labs., Ohio.
EVALUATION OF TRANSFER FILMS OF SALOX M ON 440C FOR HPOTP BEARING CAGE APPLICATIONS, TASK 119
S. A. Barber, J. W. Kannel, and K. F. Dufrane 23 Jun. 1986 69 p
(Contract NAS8-36192)
(NASA-CR-179020; NAS 1.26:179020) Avail: NTIS HC A04/MF A01 CSCL 13I

The objective of the task was to evaluate the suitability of a bronze-filled polytetra fluoroethylene (Salox M) as the cage material in Space Shuttle Main Engine (SSME) high pressure oxygen turbo pump (HPOTP) bearings. The role of the cage pocket material will be to provide a transferred lubricating interface at the ball-race contact region. A series of experiments was conducted which involved block-on-ring tests (the block was the polytetrafluoroethylene (PTFE) -filled material and the ring was through-hardened 440C steel) and high speed traction tests of two 440C disks with one disk rubbed with a PTFE block to generate a transfer film. Measurements included post test visual observations of the condition of the 440C, wear rate measurements of the blocks, and traction measurements between the disks. It was observed that both Salox M and glass-filled PTFE (Armalon) transferred PTFE to 440C at cryogenic temperatures. Bronze is also transferred to uncoated 440C from the Salox M. At room temperature no PTFE transfer was observed in the high speed disk tests due to severe frictional heating, although bronze transfer still occurred with the bronze-PTFE Salox M material. Since the bearing will operate at cryogenic temperature, transfer films are very probable. Salox M wore slightly, although probably tolerably, more than glass-filled PTFE against 440C. However, Salox M is clearly less abrasive to 440C than is the glass-filled material. When the surface layer of PTFE is depleted from the glass-filled material, the glass fibers tend to seriously abrade the steel. This problem does not occur with Salox M. The surface roughness studies indicate that smooth balls are quite reasonable for transfer films. No significant difference in wear rates of the candidate cage materials was observed when the 440C surface finish was increased from 0.025 micron to 0.1 micron cla. At higher levels of roughness, the wear rate increased. Two surface coatings (MoS2 and TiN) were tested. The surface coatings tended to reduce the Salox M wear rate and reduce bronze transfer. PTFE transfer at cryogenic temperatures still occurred with the surface coatings. Two cage design concepts are presented utilizing Salox M material. One design involves a metal-reinforced Salox M cage, while the second design uses Salox M inserts in a metal structure. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-29185# Massachusetts Inst. of Tech., Cambridge.
APPROXIMATE EVALUATION OF SEMI-MARKOV CHAIN RELIABILITY MODELS
Norman M. Wereley and Bruce K. Walker 22 Feb. 1988 22 p Prepared in cooperation with Cincinnati Univ., Cincinnati, Ohio
(Grant AF-AFOSR-0160-84)
(AD-A194669; AFOSR-88-0397TR) Avail: NTIS HC A03/MF A01 CSCL 12A

A property observed in high reliability fault tolerant control systems is the relatively rare occurrence of component failures compared to the frequent occurrence of redundancy management decision events. This property leads to a temporal decomposition of the semi-Markov chain reliability model into two times scales: a slow time scale for failure events, a fast time scale for FDI events. Conditions are described under which a perturbed semi-Markov chain can be approximated by an enlarged Markov process, the parameters of which are derived from the parameters of the semi-Markov chain. GRA

N88-29186# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF THE EFFECT OF FAULTY SPARES ON THE PERFORMANCE OF DIAGNOSTIC ALGORITHMS IN RELIABLE SYSTEMS M.S. Thesis
Mustafa Paktuna Dec. 1987 141 p
(AD-A193526) Avail: NTIS HC A07/MF A01 CSCL 12F

Previous research of systems diagnosis algorithms have assumed that replacement processors are fault-free. In practical applications, however, faults can occur in spare processors. It is shown that faulty spare processors have a surprisingly large deleterious effect on the speed of diagnosis in the universal diagnosis algorithm analyzed by Smith. The task of this algorithm is described as follows: replace a processor if it fails at least one test. The speed of diagnosis is nearly independent of the distribution of fault processors. That is, as long as the total number of fault processors is constant, the probability of repair is relatively unaffected by whether more faulty processors are in the spares or in the system. This thesis derives an asymptotic approximation to the probability of repair when faulty spares are present. An exact value can be obtained from previously known results. However, the calculations are extremely time consuming with a time complexity of order 0(4n), where n is the number of processors. Our asymptotic approximations yield good estimates that can be calculated quickly. The analysis was performed by formulating the probability of repair calculations as a multiplication of matrices and by deriving approximations to the largest eigenvalues of these matrices. Also, faster calculations were achieved by an aggregation operation on the states of the system. GRA

N88-29187# Integrated Support Systems, Inc., Clemson, S.C.
RELIABILITY AND MAINTAINABILITY (R AND M) Interim Report, Mar. - May 1988
Robert J. Hankins May 1988 62 p
(Contract F33615-84-C-0061)
(AD-A193857; AFHRL-TP-87-37) Avail: NTIS HC A04/MF A01 CSCL 15E

This paper details an Air Force Reliability and Maintainability (R and M) study which investigated the degree to which R and M logistics analyses requirements are satisfied by the Unified Data Base (UDB) for Logistics Information, a fully automated on-line interactive logistic Support Analysis Record system. The R and M study consisted of three sequential tasks: (1) investigation and definition of requirements, (2) definition of the frequency and method of specific R and M data collection, and (3) performance of comparability analyses of data elements defined in the first task and currently in the UDB. This paper includes a detailed description of the procedures followed and results of each task and provides recommendations for incorporation into the UDB. GRA

N88-29188# University of the West Indies, Mona (Jamaica). Dept. of Chemistry.
RADIOACTIVITY AS A MEANS OF NONDESTRUCTIVE TESTING
A. S. Wagh and W. Pinnock 1988 18 p Presented at the 1st Non Destructive Testing Congress for Latin America and Caribbean, Sao Paulo, Brazil, 21 Sep. 1988
(DE88-702778; INIS-BR-1080; CONF-8809282) Avail: NTIS HC A03/MF A01

An attempt is made to develop a method in which certain solutions with radioactive solutes can be used as liquid penetrants. The gamma activity can be measured using a conventional counter. This activity gives a measure of the quantity of the penetrated fluid and an assessment of the depth and size of the flaw can be determined. We discuss two cases: (1) the use of external penetrants and (2) the use of inhernet activity in the material. The first case is applicable to metallurgy while the second case is applicable to building material. The experimental arrangements will be discussed and critical comparisons with other methods will be done. The limitations of the method due to occupational health aspects will also be discussed. DOE

N88-29189# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
NONDESTRUCTIVE INVESTIGATIONS FOR SPACE USE
C. LeFloch and F. Albugues 1988 4 p
(SNIAS-881-430-105; ETN-88-92853) Avail: NTIS HC A02/MF A01

Spacecraft structures testing by infrared thermography; ultrasonic methods; acoustic emission; eddy currents; and Beta scattering is summarized. Optronic techniques which can be used to solve a large number of measuring problems are mentioned. ESA

N88-29190# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.
MATERIAL AND PROCESS SELECTION AND QUALITY CONTROL FOR ESA SPACE SYSTEMS AND ASSOCIATED EQUIPMENT
Oct. 1987 26 p
(ESA-PSS-01-70-Issue-3; ISSN-0379-4059; ETN-88-92913)
Copyright Avail: NTIS HC A03/MF A01

The requirements for a material and process selection and control program for space systems and associated equipment in which the use of controlled materials and processes is mandatory are established. ESA

N88-29355*# Alabama Univ., Huntsville.
AN EXPERT SYSTEM FOR RELIABILITY MODELING
Ernst Goss, Vani Sundaraiyer, and Alan Whitten *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 39-46 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N88-29191 Georgia Inst. of Tech., Atlanta.
NONLINEAR DYNAMIC ANALYSIS AND OPTIMAL CONTROL OF SHALLOW SHELLS Ph.D. Thesis
Jindong Zhang 1987 202 p
Avail: Univ. Microfilms Order No. DA8800050

The boundary element method (BEM) was known for some time to be an efficient numerical approach for the solution of boundary value and/or initial value problems in solid mechanics. However, the shell problem has really posed some difficulties in applying the boundary element technique. An effort is made to explore the implementation of the integral equation formulation, the technique for the optimal control of the nonlinear dynamic response of the shallow shell is developed. By considering the weak formulation for the momentum balance conditions of the shallow shell, using the so-called fundamental solutions to the differential operators of the highest order in the equilibrium equations are derived for the representation of shell displacement components. The incremental approach is applied to the nonlinear problem and the different numerical techniques are discussed. The snap-through analysis is performed based on the nonlinear integral equation formulation. The optimal control technique is developed for the control of dynamic response of the shallow shell. Based on the field-boundary-element formulation, the fewer degrees of freedom in the numerical model leads to a more efficient algorithm. The numerical examples are given to illustrate the efficiency and accuracy of the approach, and the conclusions are made to summarize the progress made. Dissert. Abstr.

N88-29192 Michigan Univ., Ann Arbor.
THICKNESS EFFECTS ON THE STABILITY OF SHELL LIKE STRUCTURES Ph.D. Thesis
Youngjoo Kwon 1987 145 p
Avail: Univ. Microfilms Order No. DA8801355

The issue of thickness effects in the stability of shell-like structures under stress is addressed. Instead of the classical approach of employing a nonlinear shell theory to analyze the bifurcation instability of interest, a multiple scale asymptotic method

is proposed which bypasses the need for a nonlinear shell theory. The method is an asymptotic expansion, with respect to the reference thickness of the shell, of the exact linearized instability equations for the three dimensional solid. First, after a short literature review, the method is briefly described and it is illustrated by means of an analytically tractable example. Secondly, the method is generalized to a broad class of rate independent shells with arbitrary geometry and arbitrary types of loading. Finite deformations are considered and two different approaches are presented. Dissert. Abstr.

N88-29193 Stanford Univ., Calif.
THE USE OF A SURFACE ACOUSTIC WAVE TECHNIQUE TO STUDY THE GROWTH BEHAVIOR OF SMALL CRACKS IN A HIGH STRENGTH STEEL ALLOY Ph.D. Thesis
Hakan Hursit Yuce 1987 189 p
Avail: Univ. Microfilms Order No. DA8801062

Fatique crack propagation in engineering materials was the subject of considerable research. Most experimental studies to determine fatigue crack growth rates and threshold stress intensity factors have considered large cracks (several millimeters in length) and generally large through cracks. However, very often in actual fatigue fractures, the fatigue process is dominated by the initiation and growth of small cracks. The importance of small cracks, both from scientific and practical view points, were recently recognized and there is substantial evidence that in many cases small cracks do not follow the crack growth laws derived from larger cracks. In this study, an ultrasonic surface acoustic wave (SAW) technique was used to monitor the depth of surface fatigue microcracks as they grow. This technique also provides information on the stress which must be applied to cause the cracks to open fully. Values of crack opening stress obtained by scanning electron microscope (SEM) measurements of crack tip opening displacements were compared with values determined acoustically. Good agreement was obtained. Results of using SAW techniques in studies of microcrack growth in 300 M steel are summarized.
Dissert. Abstr.

N88-29194# Brown Univ., Providence, R. I. Div. of Engineering.
RESULTS ON THE INFLUENCE OF CRACK TIP PLASTICITY DURING DYNAMIC CRACK GROWTH Final Report
L. B. Freund Aug. 1987 32 p
(Contracts N00014-87-K-0481; DAAG29-85-K-0003; Grant NSF DMR-87-14665)
(AD-A193460) Avail: NTIS HC A03/MF A01 CSCL 20K

Dynamic fracture processes in structural materials are often described in terms of the relationship between a measure of the crack driving force and the crack tip speed. In this article, ongoing research directed toward establishing a basis for such a relationship in terms of crack tip plastic fields is described. In particular, the role of material inertia on a small scale as it influences the perceived fracture resistance of a rate independent material is discussed. Also, the influence of material strain rate sensitivity on the development of crack tip plastic deformations, and the implications for cleavage propagation and arrest in a material that can undergo a fracture mechanism transition, is considered. The discussion is concluded with mention of a few outstanding problems in the study of dynamic fracture, including some recent experimental evidence that the traditional crack tip characterization viewpoint of fracture mechanics may be inadequate under very high rate loading conditions. GRA

N88-29195*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED FINITE STRIP MINDLIN PLATE BENDING ELEMENT USING ASSUMED SHEAR STRAIN DISTRIBUTIONS
Abhisak Chulya and Robert L. Thompson Jul. 1988 20 p
(NASA Order C-99066-G)
(NASA-TM-100928; ICOMP-88-12; E-4194; NAS 1.15:100928)
Avail: NTIS HC A03/MF A01 CSCL 20K

A linear finite strip plate element based on Mindlin/Reissner plate theory is developed. The analysis is suitable for both thin and thick plates. In the formulation new transverse shear strains are introduced and assumed constant in each two-code linear strip. The element stiffness matrix is explicitly formulated for efficient computation and computer implementation. Numerical results showing the efficiency and predictive capability of the element for the analysis of plates are presented for different support and loading conditions and a wide range of thicknesses. No sign of shear locking phenomenon was observed with the newly developed element. Author

N88-29196*# Old Dominion Univ., Norfolk, Va. Dept. of Civil Engineering.
PASSIVE DAMPING CONCEPTS FOR FREE AND FORCED MEMBER AND GRILLAGE VIBRATION Progress Report, period ending 30 Jun. 1988
Zia Razzaq and Bassam Najjar Jul. 1988 100 p
(Grant NAG1-336)
(NASA-CR-183114; NAS 1.26:183114) Avail: NTIS HC A05/MF A01 CSCL 20K

The performance of potential passive damping concepts is investigted for a long tubular aluminum alloy member, and a two-bar grillage structure. The members are restrained partially at the ends and are of the type being considered by NASA for possible use in the construction of a future space station. Four different passive damping concepts are studied and include nylon brush, wool swab, copper brush, and silly putty in chamber dampers. Both free and forced vibration tests are conducted. It is found that the silly putty in chamber damper concept provides considerably greater passive damping as compared to that of the other three concepts. For the grillage natural vibration, a five wool swab damper configuration provides greater damping than the five silly putty dampers in chamber configuration. Due to the constrained motion imposed by the vibrator used in the tests, the effectiveness of the passive dampers could not be adequately evaluated for the individual member. However, it is found that for the grillage under forced vibration, the five silly putty dampers in chamber damper configuration provides very effective passive damping although only at and around the resonant frequency. At resonance, these dampers provide a 51 percent reduction in the dynamic magnification factor for this case. Author

N88-29197# Los Alamos National Lab., N. Mex.
INFLUENCE OF PEAK PRESSURE ON THE SUBSTRUCTURE EVOLUTION AND SHOCK WAVE PROFILES OF Ti-6Al-4V
G. T. Gray, III and C. E. Morris 1988 8 p Presented at the 6th World Conference on Titanium, Cannes, France, 6 Jun. 1988
(Contract W-7405-eng-36)
(DE88-006458; LA-UR-88-625; CONF-880681-1) Avail: NTIS HC A02/MF A01

The object of the present study was to investigate the influence of peak pressure on the residual structure/property realationships and the wave profile behavior of shock-loaded Ti-6-4. A further aim was to determine if the alpha to omega phase transformation occurred in Ti-6-4 using real time VISAR and post-mortem shock recovery techniques. The following conclusions can be drawn: over the velocity range investigated no evidence of an alpha to omega phase transition was observed in Ti-6-4 with either VISAR wave profiles or shock recovery experiments; increasing peak pressure results in an increased dislocation density and yield strength in shock-loaded Ti-6-4; deformation of the {1121} type, are observed in the 10 and 13 GPa range; the low pressure Hugoniot for Ti-6-4 is given by U sub s = 5.123 km/s + 1.083 U sub p for U sub p less than 1.4 km/s; the high pressure relation is given by U sub s = 5.030 + 1.056 U sub p . DOE

N88-29198# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
ELASTIC-PLASTIC ANALYSIS OF PART-THROUGH CRACK PROPAGATION IN PIPING AND PRESSURE VESSELS
L. A. deSouza and N. F. F. Ebecken 1986 13 p In PORTUGUESE; ENGLISH summary Presented at the 4th Brazilian Symposium on Piping and Pressure Vessels, Salvador, Brazil, 28 Oct. 1986

(DE88-701619; INIS-BR-965; CONF-8610317) Avail: NTIS (US Sales Only) HC A03/MF A01

The shell structures, often used in the construction of reservoirs, pipings, pressure vessels, nuclear power plants, etc., with part-through crack along its thickness, are analyzed, using a computer system developed by the finite element method. The surface is discretized with three-dimentional quadratic elements, degenerated in its mid-surface, such that the fracture is simulated by scalar elements (nonlinear springs). The results are analyzed by the stress intensity factor K(sub I) and the strain energy release rate, which is known as J-integral. The analysis is performed in the elastic and elasto-plastic regime. The basic hypothesis and the formulation adpoted in the derivation of the scalar elements are also shown. DOE

N88-29199# Dayton Univ., Ohio. Research Inst.
PLASTIC FLOW AND FAILURE MODELING UNDER HIGH STRAIN RATE LOADING Final Report, Aug. 1984 - Apr. 1987
A. M. Rajendran and S. J. Bless Feb. 1988 133 p
(Contract F33615-84-C-5045)
(AD-A194223; UDR-TR-87-71; AFWAL-TR-87-4134) Avail: NTIS HC A07/MF A01 CSCL 11F

High strain rate properties were determined for several metals at room and high temperatures. Split Hopkinson bar (SHB) tests under both tension and compression were performed for obtaining stress-strain curves at different strain rates. Quasistatic tests were also conducted and were compared with the SHB test results. High speed photographs of the necking process in tensile SHB samples were taken and the stress-strain curves beyond necking for 1020 and HY 100 steels, and 6061-T6 aluminum were determined. A technique to heat SHB tensile samples using an induction coil technique was successfully developed. An experimental configuration in which a flyer plate impacts a long rod was used to determine the initial yield stress for three steels. Manganin gage stress measurement technique was used in this experiment. Plate impact tests were also conducted to determine precursor decay, steady state value for HEL, and spall strength. It was also demonstrated that the use of the manganin gage can be extended to determine transverse stresses in a plate impact test. A methodology to determine shock velocity at very high pressures using manganin gages is also presented. GRA

N88-29200# Naval Postgraduate School, Monterey, Calif.
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF UNDERWATER EXPOSURE ON THE DAMPING CHARACTERISTICS OF BOLTED STRUCTURAL CONNECTIONS FOR PLATES AND SHELLS M.S. Thesis
Richard W. Durham Mar. 1988 61 p
(AD-A194486) Avail: NTIS HC A04/MF A01 CSCL 20K

Recent studies have shown that use of the bolted structural connection and the introduction of a viscoelastic material at the joint build-up can reduce the vibration response of a structure. Many potential applications utilizing this type of vibration reduction must operate in an underwater environment. A test structure consisting of two concentric circular shells connected by four vanes and assembled with bolts was tested to determine the effects of underwater exposure on the damping properties of a bolted structure. The effects of underwater exposure on system damping were examined for various structural bolt torques and for the application of a viscoelastic layer at the joint interfaces. With increasing underwater exposure time, the modal frequencies, damping and response amplitude remained constant. The changes in the frequency response of the structure with underwater exposure resulted from the effects of increased viscous fluid layer damping at the joint interfaces. As water replaced the air at the joint interfaces, with continued underwater exposure, the effects of viscous fluid layer damping increased. GRA

N88-29201# Brown Univ., Providence, R. I. Div. of Engineering.
CRITICAL CONDITIONS FOR FAILURE IN MATERIALS SUBJECTED TO HIGH RATES OF LOADING Final Technical Report, 1 Dec. 1984 - 31 Dec. 1987
R. J. Asaro, R. J. Clifton, J. Duffy, L. B. Freund, and A. Needleman 28 Mar. 1988 26 p
(Contract DAAG29-85-K-0003)
(AD-A194697; ARO-22306.12-EG) Avail: NTIS HC A03/MF A01 CSCL 11F

Dynamic shear band formation in steels has been investigated in torsional Kolsky bar experiments. Temperature profiles have been measured. Stress-time curves have been related to analytical predictions of localization in simple shear. Good agreement between theory and experiment is obtained when the effects of strain hardening, thermal softening, strain rate sensitivity, and geometric imperfections are included in the theory. The analysis of shear strain localization has been extended to the case of plane strain compression. Heat conduction has been included in the analysis of quasi-static deformations. Critical conditions for dynamic and quasi-static fracture initiation of AISI 1020 steel have been determined for three microstructures over the temperature range -150 C to +150 C. Fracture models for both cleavage fracture and ductile rupture have been developed for interpreting the observed behavior over the full range of temperatures and loading rates. The effect of loading rate on the fracture toughness of 4340 VAR steel has been investigated through experiments involving explosive loading of notched tensile bars and through plate impact experiments on pre-cracked plates. Numerical methods have been developed for the interpretation of the plate impact experiments. GRA

N88-29202# Washington Univ., Seattle. Dept. of Mechanical Engineering.
J-INTEGRAL MEASUREMENT USING MOIRE INTERFEROMETRY
M. S. Dadkhah, A. S. Kobayashi, F. X. Wang, and D. L. Graesser Apr. 1988 19 p
(Contract N00014-85-K-0187)
(AD-A193751; UWA/DME/TR-88/59) Avail: NTIS HC A03/MF A01 CSCL 20F

An improved moire interferometry, which records both the vertical and horizontal displacements simultaneously, was used to determine the J-integral within the confine of a constitutive relation. J-values, which are associated with stable crack growth in biaxially loaded 2024-T3 aluminum, single edge notched specimens, were found to be path independent and increased with crack extension. GRA

N88-29203# Air Force Astronautics Lab., Edwards AFB, Calif.
ANTI-ALIASING FILTERS FOR DYNAMICS AND CONTROL EXPERIMENTS Special Report, Dec. 1986 - Aug. 1987
John M. Ward, Angel L. Cruz, and Alok Das Mar. 1988 26 p
(AD-A193758; AFAL-TR-88-030) Avail: NTIS HC A03/MF A01 CSCL 12E

In an effort to test and evaluate various system identification concepts, the AFAL has designed and constructed a lightly damped aluminum grid structure. The idea is to vibrate the grid with a known input force, measure the sensed output, and compare the modal frequencies and shapes predicted by various identification methods with the actual modal data. In order to accurately obtain the actual modal data, the measured grid output must pass through signal conditioning electronics. This report entails the design of a 16 channel 6th order butterworth anti-aliasing filter utilized as part of the signal conditioning electronics for the grid structure. GRA

N88-29204# Anamet Labs., Inc., Hayward, Calif.
INTERACTIVE PLOTTING OF NASTRAN AERODYNAMIC MODELS USING NPLOT AND DISSPLA Final Report, Jun. - Aug. 1987
Steven G. Harris Mar. 1988 32 p
(Contract F33615-84-C-3216)
(AD-A194115; Rept-587-1A; AFWL-TR-87-99) Avail: NTIS HC A03/MF A01 CSCL 01A

The computer program NPLOT is extended to permit interactive plotting of NASTRAN doublet lattice aerodynamic models. In addition, a translator is developed between Precision Visuals DI-3000 plot package and ISSCO's DISSPLA plot package to permit NPLOT to be run at facilities that support only DISSPLA. The

resulting package is useful as a general debugging tool for NASTRAN aerodynamic analysis and as an integral part of nuclear vulnerability model generation programs developed in previous work. GRA

N88-29205# Technische Hogeschool, Delft (Netherlands).
NONLINEAR VIBRATIONS OF IMPERFECT THIN WALLED CYLINDRICAL SHELLS Ph.D. Thesis
Da-Kang Liu 1988 283 p Sponsored by the Chinese Educational Committee; the Chinese Academy of Sciences and Technische Hogeschool, Delft, The Netherlands
(ETN-88-92904) Avail: NTIS HC A13/MF A01

The influence of initial geometric imperfections on the nonlinear vibration behavior of shells, and the effect of different boundary conditions were analyzed. Donnell shallow shell equations are used with the appropriate damping, inertial, and initial geometric imperfection terms included. Galerkin's procedure and the method of averaging are employed to reduce the problem to the solution of nonlinear algebraic and nonlinear ordinary differential equations, respectively. Numerical solutions indicate that the initial geometric imperfections have a strong influence on the nonlinear vibrations of shells if certain coupling conditions are satisfied. The imperfections significantly change the natural frequencies and the degree of nonlinearity, and may also change the vibration behavior. Results show that the effect of boundary conditions on the nonlinear vibrations of shells may be significant especially for shorter shells. ESA

N88-29206 British Petroleum Co. Ltd., London (England).
TESTING DEGRADATION OF A SAMPLE UNDER THERMAL CYCLING Patent Application
David Chinery, inventor (Brit. Petroleum), David Antony Elmes, inventor (Brit. Petroleum), and John Kimberley Wells, inventor (Brit. Petroleum) 23 Sep. 1987 4 p Filed 12 Mar. 1987 Priority 18 Mar. 1986 GB
(GB-Patent-2-188-163-A; GB-Patent-Appl-SN-8705827; Int-Patent-Class-G01N3/18; ETN-88-93124) Avail: UK Patent Office, 25 Southampton Buildings, London WC2A 1AY, United Kingdom

An apparatus in which a sample of material is thermally cycled by means of one or more Peltier devices, one junction of each device being in contact with the sample and the other junction in contact with a heat sink is described. The temperature of the heat sink may be thermostatically stabilized using an ancillary fluid circuit supplied with ice/water, water/antifreeze. By changing the electrical power to the Peltier devices, the sample may be heated and/or cooled as desired. The sample may be thermally cycled while being mechanically loaded for creep or strength degradation testing. The sample temperature may be sensed to enable feedback control of the thermal cycle. ESA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-29207# Exlog/Brown and Ruth Labs., Inc., Englewood, Colo.
NONSEISMIC, SURFACE GEOPHYSICAL AND GEOCHEMICAL PROSPECTING TECHNOLOGY Final Report, Nov. 1986 - Nov. 1987
J. B. Curtis and J. L. Gevirtz Oct. 1987 107 p
(Contract GRI-5086-215-1413)
(PB88-196613; GRI-88/0056) Avail: NTIS HC A06/MF A01 CSCL 08G

The exploration value of detecting low concentrations of hydrocarbons (HCs) entrapped in soils has been subjected to considerable debate. Proponents of the various methods assert that microseepage involves vertical migration of HCs, a mode of HC movement that is different than that documented for macroseeps. Earlier studies have suffered from less-than-rigorous sampling designs that lead to statistically untestable conclusions. And no universally acceptable genetic models that quantitatively relate asserted causes, mechanisms, and effects of microseepage have been defined. A series of experiments to complete an objective study are outlined. The objective study is designed to: (1) rigorously establish the genetic relationships between measurement of soil HC populations and postulated soil alteration products and their geophysical and remote sensing expression. This would allow: (2) the determination of what these surface measurements tells about the HC character, geology, and hydrodynamics of the subsurface. Results of such an experiment could then be used to: (3) test the concept of vertical HC migration and improve the application of microseep detection methods. Author

N88-29208# Forschungsinstitut fuer Informationsverarbeitung, Ettlingen (West Germany).
AUTOMATIC LINE NETWORK EXTRACTION FROM AERIAL IMAGERY OF URBAN AREAS THROUGH KNOWLEDGE-BASED IMAGE ANALYSIS Interim Report No. 4
H. Kazmierczak 19 Jan. 1988 12 p
(Grant DAJA45-86-0049)
(AD-A192399) Avail: NTIS HC A03/MF A01 CSCL 08B

Investigations of three different methods for the automatic extraction of the traffic network from aerial imagery of rural as well as urban areas have shown the strengths and weaknesses of these methods. A method for the automatic extraction of line objects from large aerial images of prevailing rural areas works successfully in this domain. However, when applied to images of urban areas, success and reliability of the method decrease remarkably due to the complex mixture of natural and man made objects at those locations. A next method we have examined is best described as knowledge-based approach for the analysis of aerial images. In this approach image analysis is performed at three levels of abstraction, namely iconic or low-level image analysis, symbolic or medium-level image analysis, and semantic or high-level image analysis. Domain dependent knowledge about prototypical urban areas is incorporated via a semantic network. However, depart from using enhanced segmentation, we decided not to follow this approach, because a third method we have investigated will promise reasonable results at lower cost. This method uses a blackboard-oriented production system for image understanding. Under the premise that the crossings of the traffic network can be detected, this method is able to extract the traffic network from aerial images of a complexity like the Bietigheim image (South-West Germany). Our approach for the automatic extraction of the traffic network from aerial images consists of a combination of the 3 methods described. GRA

N88-29209# Cornell Univ., Ithaca, N.Y. Mathematical Sciences Inst.
DISTORTION ESTIMATES FOR NEGATIVE SCHWARZIAN MAPS
John Guckenheimer and Stewart Johnson 29 Feb. 1988 13 p
(Contract DAAG29-85-C-0018)
(AD-A193172; ARO-23306.157-MA) Avail: NTIS HC A03/MF A01 CSCL 12A

One-dimensional maps with a negative Schwarzian derivative are shown to have area preserving properties: the distortion dis(f) = f'/(f')2 varies inversely proportional to the vertical distance from a critical point for maps f with negative Schwarzian; maps consisting of monotone branches mapping across an interval either have a sigma-finite absolutely continuous ergodic measure or a universal attractor at the ends of the interval. The Schwarzian derivative was defined H.A. Schwartz in connection with the study of conformal maps of the complex plane. The derivative has found an interesting application in the study of one-dimensional maps where the assumption of a negative Schwarzian has been used to establish topological conjugacy between unimodal maps with identical kneading sequences. This and other one-dimensional applications arise from inherent measure preserving properties of maps with a negative Schwarzian derivative. The authors attempt in this paper is to make these properties more explicit. GRA

N88-29210*# Washington State Univ., Pullman. Dept. of Astronomy and Soils.
SPECTRAL CHARACTERISTICS AND THE EXTENT OF PALEOSOLS OF THE PALOUSE FORMATION Final Report
B. E. Frazier, Alan Busacca, Yaan Cheng, David Wherry, Judy Hart, and Steve Gill Aug. 1988 41 p
(Contract NAS5-28758)
(NASA-CR-180947; NAS 1.26:180947) Avail: NTIS HC A03/MF A01 CSCL 08M

The objective of this study is to test the hypothesis that TM data is adequate in band selection and width and in spatial resolution to distinguish soil organic matter, iron oxide, and lime-silica contents to map several severity classes of erosion in soils of the Palouse region. The methodology used is as follows: (1) To develop spectral relationships from TM data that define the spatial distribution of soil areas by levels of (1) organic matter in the surface soil, (2) iron oxide and clay in exposed paleosol B horizons, and (3) lime-silica accumulations in exposed paleosol B horizons; (2) To compare areas determined by the method outlined in 1 to patterns interpreted from color aerial photos, and to ground observations on bare-soil fields; and (3) To define, on the basis of results of 1 and 2 to the extent possible, where exposed paleosols exist within fields that are not bare, but have a crop cover, and the distribution of desirable and undesirable soil properties in each field. Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-29211# Pacific Wind Energy, Inc., Corvallis, Oreg.
EFFECTS OF PRECIPITATION ON WIND TURBINE PERFORMANCE
S. N. Walker and J. E. Wade Mar. 1988 66 p
(Contracts DE-AC02-83CH-10093; DE-FC02-85CH-10289)
(DE88-001144; SERI/STR-217-3287) Avail: NTIS HC A04/MF A01

This report examines the effects of precipitation on the performance of a wind turbine, with an airfoil section similar to that of the MOD-O (23000 series), at an operating wind farm. Earlier NASA research noted a performance degradation of up to 24 percent for the MOD-OA when precipitation occurred. The objective of this study was to collect sufficient data at a wind farm where rainfall occurs frequently so that the effect of precipitation could be discriminated from the effects of the turbulence that may be associated with rain. The rainfall rates were considerably lower than the rates of rainfall considered in the previous NASA study. The rainfall rates experienced at the wind farm are generally below 8mm/h and would usually fall under the light rain classification of the previous NASA study. For light rain conditions, the NASA report showed as high as an 18 percent decrease in machine performance. The study described here did not show a decrease in performance from light rain; rather an increase of approximately 3 percent was indicated. The 3 percent increase may be attributable to a reduction of blade roughness, rain effects on the anemometer, or a combination of the two. The general conclusion is drawn for this study: for the ESI-54 wind turbine studied, for rainfall rates generally less than 8mm/h, the rain has a beneficial effect on performance by slightly improving the aerodynamic properties (maintaining clean blades). DOE

N88-29212# Midwest Research Inst., Golden, Colo.
DYNAMIC RESPONSE OF A 330-kW HORIZONTAL AXIS WIND TURBINE GENERATOR
M. Wehrey, I. Redmond, C. Anderson, and P. Jamieson Feb. 1988 102 p
(Contract DE-AC02-83CH-10093)
(DE88-001136; SERI/STR-217-3203) Avail: NTIS HC A06/MF A01

The results of a combined experimental and theoretical study of the dynamic response of a Howden 330/26 wind turbine generator are given. The work was undertaken to extend the current knowledge on the dynamic response of wind turbines, and to better understand 3-D air-flow patterns. Tests involved performance and dynamic strain measurements on one of the three rotor blades and on the structural members of the wind turbine and its tower. Also, detailed measurements of the ambient wind inflow to the turbine were made using a vertical plane array of anemometers. The results of the tests were then compared with model predictions. In general, structural loads computed using the model were lower than their measured counterparts. Blade and mean flapwise loads, measured using time averaging, agreed reasonably with those derived from machine start/stop sequences. Tower steady bending loads, also measured from start/stop sequences, agreed fairly well with each other and with theoretical predictions using the dynamic response model. Power and wind speed are also much as predicted. Flow visualization was also conducted, where photos were taken of the operating blade and correlated with real-time data records. Binned separation data produced convincing correlations. The measured separation point data were processed to yield lift coefficient values, which were compared with similarly processed separation data obtained from wind tunnel tufting studies. Stall appeared to be delayed on the blade, probably due to radial flow. DOE

N88-29213# Beta Power, Inc., Wayne, Pa.
CONSIDERATIONS AND MEASUREMENTS OF LATENT-HEAT-STORAGE SALTS FOR SECONDARY THERMAL BATTERY APPLICATIONS
A. A. Koenig, J. W. Braithwaite, and J. R. Armijo 16 May 1988 21 p Presented at the 7th DOE/EPRI Beta Battery Workshop, Toronto, Ontario, 1 Jun. 1988 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-011091; SAND-88-1324C; CONF-8806127-1) Avail: NTIS HC A03/MF A01

Given its potential benefits, the practicality of using a latent heat-storage material as the basis for a passive thermal management system is being assessed by Chloride Silent Power Ltd. (CSPL) with technical assistance from Beta Power, Inc. and Sandia National Laboratories (SNL). Based on the experience gained in large-scale solar energy storage programs, fused salts were selected as the primary candidates for the heat-storage material. The initial phase of this assessment was directed to an

EV battery being designed at CSPL for the ETX-II program. Specific tasks included the identification and characterization of potential fused salts, a determination of placement options for the salts within the battery, and an assessment of the ultimate benefit to the battery system. The results obtained to date for each of these tasks are presented in this paper. DOE

N88-29214# Sandia National Labs., Albuquerque, N. Mex.
PLANARIZATION OF METAL SUBSTRATES FOR SOLAR MIRRORS
C. S. Ashley, S. T. Reed, and A. R. Mahoney 1988 4 p Presented at Better Ceramics Through Chemistry III, Reno, Nev., 5 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE88-011492; SAND-88-0234C; CONF-8804114-4) Avail: NTIS HC A02/MF A01

The planarizing ability of sol-gel films was investigated on several as-rolled stainless steel substrates. The smoothing effect afforded by the films was evaluated, using optical techniques, following deposition of silver over the planarized substrates. The specular reflectance of various substrates, initially ranging from 0.36 to 0.90, could be improved to final reflectance values of approximately 0.93 with sol-gel processing. This process is being used to prepare prototype foil mirrors for evaluation in the next generation of solar concentrators. DOE

N88-29215# Ceramatec, Inc., Salt Lake City, Utah.
DEVELOPMENT OF PLANAR GEOMETRY SOLID OXIDE FUEL CELL TECHNOLOGY, PHASE 1 Final Report, 1 Jul. 1986 - 31 Jul. 1987
A. C. Khandkar and D. W. Prouse Jul. 1987 97 p
(Contract GRI-5086-294-1292)
(PB88-210356; PROG-87015308; GRI-87/0297) Avail: NTIS HC A05/MF A01 CSCL 10A

A developmental effort on fabrication of a planar geometry solid oxide fuel cell (SOFC) is reported. Fabrication technology was developed to produce planar geometry SOFCs. Ceramatec has successfully developed and demonstrated thin, flat, and gas impermeable electrolyte membranes of 2 1/4 in x 2 1/4 in square planar area x 0.002 to 0.005 in thicknesses. The flatness achieved on these electrolyte membranes allowed development of screen printing techniques for depositing the anode and cathode layers. Ceramic block manifolds were fabricated for manifolding the single cell subassemblies. Single cell SOFC tests were conducted at IFC. The measured OCVs were found to agree well with the theoretical OCV's for H2/O2, H2/air, CH4/O2 and CH4/air as the fuel gas/oxidant gas reactants, respectively. Author

N88-29216# Temple Univ., Philadelphia, Pa. Dept. of Chemistry.
HYDROGEN CONCENTRATION CELLS AS CONVERTERS OF HEAT INTO ELECTRICITY Final Report
R. E. Salomon Oct. 1987 50 p
(Contract DE-FG01-85CE-15218)
(DE88-009662; DOE/CE-15218/T1) Avail: NTIS HC A03/MF A01

The properties of the platinum coated Nafion hydrogen pressure cell have been determined over a range of conditions and as a function of the variable parameters associated with the preparation of this cell. Other protonically conducting membrane cells have been prepared with both commercially available membranes and membranes synthesized in our laboratory but we have been unable to find any membrane, which works better in the application described here, than Nafion. Two different Nafion membranes have been utilized in this work (125 and 117) and the differences between them were negligible. Accordingly, the bulk of this report will deal with the platinum coated Nafion hydrogen pressure cell. As part of our efforts to enhance cell conductance, solution composition was varied as was time of contact with the platinizing solution. The efficacy of multiple coatings was also analyzed. Other metals were tried as electrocatalysts as were other methods of reduction (hydrazine and molecular hydrogen) in place of our main reducing agent, sodium borohydride. Various cell configurations were designed, built and tested and as a result of this we have determined that high pressure contacts are most desirable. We have determined the pressure and temperature dependence of these cells and in the course of this have found a super-Nernstian cell behavior which has both practical and theoretical significance for this invention. Two concentration cell systems have been assembled and tested for some periods of time and the results suggest that the two concentration cell converter may be most useful when the low temperature is subambient and the high temperature heat source is at ambient. DOE

N88-29217# California Univ., Berkeley. Lawrence Berkeley Lab.
UNSTABLE HEAT PIPES
M. J. McGuinness and K. Pruess Oct. 1987 6 p Presented at the 9th New Zealand Geothermal Workshop, Auckland, New Zealand, 4 Nov. 1987
(Contract DE-AC03-76SF-00098)
(DE88-010780; LBL-24092; CONF-871111-1) Avail: NTIS HC A02/MF A01

Heat pipes are an important feature of models of vapor-dominated geothermal reservoirs. Numerical experiments reveal that a vapor-dominated heat pipe is unstable if pressure is controlled at shallow levels. This instability is discussed in physical terms, and some implications for geothermal reservoirs are considered. DOE

N88-29218# Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto.
ABSORPTION HEAT PUMPS
M. Huhtinen, M. Heikkilae, and R. Andersson Mar. 1987 89 p In FINNISH; ENGLISH summary
(DE88-752820; KTM/E-D-120) Avail: NTIS (US Sales Only) HC A05/MF A01

The aim of the study was to analyze the technical and economic feasibility of absorption heat pumps in Finland. The work was done as a case study: the technical and economic analyses have been carried out for six different cases, where in each the suitable size and type of the heat pump plant and the auxiliary components and connections were specified. The study also detailed the costs concerning the procurement, installation and test runs of the machinery, as well as the savings in energy costs incurred by the introduction of the plant. Conclusions were drawn of the economic viability of the applications studied. The following cases were analyzed: heat recovery from flue gases and productin of district heat in plants using peat, natural gas, and municipal wastes as a fuel. Heat recovery in the pulp and paper industry for the upgrading of pressure of secondary steam and for the heating of white liquor and combustion and drying the air. Heat recovery in a peat-fulled heat and power plant from flue gases that have been used for the drying of peat. According to the study, the absorption heat pump suits best to the production of district heat, when the heat source is the primary energy is steam produced by the boiler. Included in the flue as condensing is the purification of flue gases. Accordingly, benefit is gained on two levels in thick applications. In heat and power plants the use of absorption heat pumps is less economical, due to the fact that the steam used by the pump reduces the production of electricity, which is rated clearly higher than heat. Author

N88-29219# International Centre for Theoretical Physics, Trieste (Italy).
THEORETICAL INVESTIGATION ON HETEROJUNCTION SOLAR CELL
K. Prema and K. Geetha Nov. 1986 9 p
(DE88-701837; IC-86/351) Avail: NTIS (US Sales Only) HC A02/MF A01

The study of thin film solar cells has proved that the surface is rough. A two-dimensional method based on the integral equation technique to analyze thin film solar cells has been developed. Presented is an analysis of a thin film solar cell using the above techniques. Variation of the minority carrier concentration, the

saturation current and the junction current of the solar cell with surface roughness is presented. DOE

N88-29220# Midwest Research Inst., Golden, Colo.
SERI'S PHOTOVOLTAIC RESEARCH PROJECT: A FOUNDATION FOR TOMORROW'S UTILITY-SCALE ELECTRICITY
R. L. Mitchell and T. Surek May 1988 11 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. 1988
(Contract DE-AC02-83CH-10093)
(DE88-001161; SERI/TP-211-3354; CONF-880702-12) Avail: NTIS HC A03

Recent progress and future directions in PV research managed by SERI for the U.S. Department of Energy (DOE) are reviewed. The primary emphases of the research are on thin-film single-junction and multijunction devices. However, work also continues on advanced crystalline silicon sheet materials. Improvements in materials and processing, solar cell design, and cell fabrication techniques have led to continuing improvements in cell efficiencies in nearly all material areas. Recent research has identified the criticality of source-material purity and device-processing conditions for different PV materials. Attention to total device design and processing has increased understanding of metallic contacts, transparent conductors, and intermediate layers. Sophisticated models have been developed to quickly assess device concepts. Enhanced measurement and characterization techniques, along with increased interactions among PV scientists, are adding to the strong foundation of photovoltaics. Future directions in PV research are given in the recent Five Year Research Plan prepared by DOE. The plan is predicated on partnerships among the Federal government, private firms, universities, and electric utilities. As part of a consensus review of the plan, this multifaceted PV community identified the specific technical goals and pertinent R and D needed for success. These technical goals and future research are described in detail. DOE

N88-29221# Sandia National Labs., Albuquerque, N. Mex.
LIQUID METAL THERMAL-ELECTRIC CONVERTER ELECTRODE DEVELOPMENT
J. I. Martinez, ed. Feb. 1988 70 p
(Contract DE-AC04-76DP-00789)
(DE88-009252; SAND-87-7025) Avail: NTIS HC A05/MF A01

Distributed receiver technology development is described. Dish-electric systems are being pursued in an effort to circumvent the need for energy transport by providing for heat-to-electricity energy conversion by individual heat engines at the focal point of parabolic dish concentrators. The Liquid Metal Thermal-Electric Converter is an engine that can convert thermal energy to electricity without the need for moving parts. The report documents the results of contracted work in the development of a long-lifetime, high-performance electrode for LMTEC, including the materials prepared for it. DOE

N88-29222# Naval Postgraduate School, Monterey, Calif.
CONSTRUCTION OF GALLIUM ARSENIDE SOLAR CONCENTRATOR FOR SPACE USE M.S. Thesis
Chris L. Hudec Mar. 1988 120 p
(AD-A194658) Avail: NTIS HC A06/MF A01 CSCL 09A

A Gallium Arsenide (GaAs) Solar Concentrator Array (SCA) was constructed using the recently developed Fresnel lens technology. The parts used were a mixture of space qualified components and readily available off-the-shelf items. The objective of the test is to verify that the SCA would substantially increase the array's power output and reject the high thermal radiation it would encounter in space. It was found that the 3 by 3 GaAs SCA power output increased from 29.88 mW to 433.71 mW. The thermal analysis and the steady state cell operating temperature calculation showed that the SCA's thermal design would keep the GaAs solar cells at a steady state temperature of 50.7 C. However, because of the low intensity level of the light source available for use the cell operating temperature was only 27 C. This was considered to be inconclusive in determining the adequacy of the thermal design. GRA

N88-29223# Technische Univ., Munich (West Germany). Fakultaet fuer Maschinenwesen.
LONG-TERM BEHAVIOR OF ENERGY PRODUCTION SYSTEMS WITH THE EXAMPLE OF HELIOS AND SYMPHONIE Ph.D. Thesis [DAS LANGZEITVERHALTEN VON ENERGIEVERSORGUNGSSYSTEMEN AM BEISPIEL HELIOS UND SYMPHONIE]
Joachim G. Kehr 1987 196 p In GERMAN
(ETN-88-92988) Avail: NTIS HC A09/MF A01

Material degradation procedure is studied on two different solar generator cells from HELIOS and SYMPHONIE on a time span of 10 yr. Silicon solar generator behavior is analyzed relative to its radiation resistance by a correlation procedure. Degradation spectra and coefficients obtained experimentally are converted into monoenergetic equivalent fluxes. Main degradation parameters considered are radiation effects, temperature, and surface damage. For determination of power losses by surface degradation an optical model of the system surface glass/junction/cell is developed. ESA

N88-29224# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
SOLAR DYNAMIC POWER SYSTEMS Final Report [SOLARDYNAMISCHE ENERGIEVERSORGUNGSSYSTEME]
Aug. 1987 531 p In GERMAN Prepared in cooperation with AEG-Telefunken, Wedel, Fed. Republic of Germany; Dornier-Werke GmbH, Friedrichshafen, Fed. Republic of Germany; MAN AG, Munich, Fed. Republic of Germany, and Erno Raumfahrttechnik GmbH, Fed. Republic of Germany
(Contract BMFT-STU-8603/8)
(ETN-88-92969) Avail: NTIS HC A23/MF A01

The potential of solar dynamic space power systems as an alternative for photovoltaic power systems was investigated, in the power range between 25 and 300 kW. The requirements for the systems, the systems analysis methods, the system concepts, and the evaluation method are outlined. Status and trends, systems definition and operational aspects, energy storage concepts, energy processing and distribution, system concepts, and systems components development problems of photovoltaic systems are presented. Status, systems engineering, determining system components, completing components, system concepts, and potential problems of solar dynamic systems are discussed. Energy storage concepts for solar dynamic power systems are presented. The advantages and disadvantages of solar dynamic and photovoltaic power systems are compared. ESA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-29225# Oak Ridge National Lab., Tenn.
REGIONAL ENVIRONMENTAL STUDIES USING NATIONAL DATA BASES AND GIS (GEOGRAPHIC INFORMATION SYSTEM)
R. J. Olson, R. A. McCord, K. C. Dearstone, and S. P. Timmins 1988 18 p Presented at the 8th ESRI Annual User Conference, Palm Springs, Calif., 21 Mar. 1988 Prepared in cooperation with Analysas Corp., Oak Ridge, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-008368; CONF-880385-1) Avail: NTIS HC A03/MF A01

The Environmental Sciences Division at Oak Ridge National Laboratory has conducted a variety of regional and national studies of potential environmental impacts related to energy development. These studies have included the assessment of acid deposition impacts, assessment of global climate change, environmental impact and risk analysis, and landscape pattern analysis. We have compiled the Geoecology and ADDNET data bases for regional

studies. These data bases contain extensive national data regarding soils, land use, agriculture, forestry, aquatic resources, endangered species, natural areas, air quality, emissions, and climate. SAS is used for data management, analysis, and display. An in-house geographic information system (GIS) is also used for mapping. In 1986 we acquired the ARC/INFO system to enhance our GIS capabilities and to be compatible with other federal agencies. Our evaluation of lake chemistry data from the Environmental Protection Agency's National Surface Water Survey demonstrates the use of GIS as a tool for regional studies. In addition, the interfacing of SAS data sets and ARC/INFO attribute files is discussed. DOE

N88-29226# Unisearch Associates, Inc., Concord (Ontario).
THE 1985-86 MEASUREMENTS WITH THE TUNABLE DIODE LASER ABSORPTION SPECTROMETER Final Report
G. I. Mackay and H. I. Schiff 12 Apr. 1988 195 p Sponsored by Coordinating Research Council, Inc., Atlanta, Ga.
(PB88-214002; CRC-APRAC-AP-10) Avail: NTIS HC A09/MF A01 CSCL 13B

A Tunable Diode Laser Absorption Spectrometer (TDLAS) system has been developed for measurement of atmospheric trace substances. Subsequently the repertoire of atmospheric gases which can be measured by this technique was extended to include NH3, H2O2, SO2 and HCHO. The system was modified to permit the near simultaneous measurements of two species. This was accomplished by incorporating two separate cold heads, each containing a set of 4 diode lasers. The Unisearch and AES TAMS-2B instruments participated in an HNO3 intercomparison study at Claremont, Calif. in September 1985. The TDLAS data agreed within combined uncertainties with the FTIR and denuder difference methods but were lower than filter pack measurements and higher than the annular denuder measurements. The agreement between measurements made by TDLAS, the fluorometric methods and bubbler techniques for H2O2 was not as good. The results of these measurements are being prepared for publication. Author

N88-29227 Rhode Island Univ., Kingston.
ATMOSPHERIC DEPOSITION OF NITRATE TO THE OCEAN SURFACE Ph.D. Thesis
Alexander A. P. Pazenny 1987 286 p
Avail: Univ. Microfilms Order No. DA8800156

Average aerosol nitrate concentrations of approximately 1.7 (n = 4) and 1.8 (n = 8) nmol/cu m, respectively, were measured at Cape Matatula, American Samoa during July-August, 1981 and at ninety Mile Beach in northern New Zealand during July-August, 1983. These concentrations are approximately 50 percent (aerosol) and 20 percent (volatile) of the concentrations reported previously for a region approximately 1000 km northeast of Samoa and south of the Equator. These differences and sedimentary aeolian mineral distributions suggest that the South Pacific Convergence Zone is an effective boundary between two tropical-subtropical tropospheric circulation regimes. An aerosol dry deposition model tended to underpredict measured values of seasalt deposition to surrogate surfaces by a factor of approximately 2. Explicit accounting for wind speed fluctuations and/or using a drag coefficient specific for the surrogate surface collectors may improve predictions. Results of extending the aerosol deposition modelling approach to nitrate aerosols, along with modeling of volatile nitrate dry deposition, suggest that the two nitrate forms may contribute approximately equally to dry deposition to surrogate and to the ocean surface. Summation with estimates of global deposition to continents and comparison with a global source inventory suggest that the tropospheric odd-nitrogen cycle is approximately balanced. Estimated fixed nitrogen sources for the Sargasso Sea euphotic zone appear to be insufficient to meet estimated requirements for new production. Dissert. Abstr.

N88-29228 Institut d'Aeronomie Spatiale de Belgique, Brussels.
ULTRAVIOLET ABSORPTION CROSS SECTIONS OF CHLORO- AND CHLOROFLUOROMETHANES AT STRATOSPHERIC TEMPERATURES
P. C. Simon, D. Gillotay, N. Vanlaethem-Meuree, and J. Wisemberg 1988 59 p Submitted for publication
(Contract EEC-303-78-1)
(Aeronomica-Acta-A-324-1988; ISSN-0065-3713; ETN-88-92722)
Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

Absorption cross sections of nine halomethanes (CCl4, CHCl3, CH2Cl2, CH3Cl, CFCl3, CF2Cl2, CF3Cl, CHFCl2, and CHF2Cl) measured between 174 and 250 nm for temperatures ranging from 225 to 295 K, are presented with uncertainties ranging from 2 percent to 4 percent and compared with previous determinations made for comparable temperature range. The largest temperature effect which takes place near the absorption threshold decreases the absorption cross section by up to 50 percent for highly chlorinated methanes but is negligible for molecules highly stabilized by hydrogen and/or fluorine. Extrapolated values for temperature of aeronomical interest are presented as well as parametrical formulas which give absorption cross section values for given wavelength and temperature ranges. ESA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-29229 Connecticut Univ., Storrs.
MECHANICS OF THRUST FAULT FORMATION Ph.D. Thesis
Paul Allyn Washington 1987 215 p
Avail: Univ. Microfilms Order No. DA8800248

Thrust faults in layered materials follow stepped trajectories comprised of alternating flats (layer-parallel segments) and ramps (segments oblique to layering). New thrust faults generally form in the footwalls of active thrust. By examining the evolving stress fields in the footwalls of active stepped thrusts, a mechanical model for the formation of thrust surfaces is developed. Analysis of displacements and sheet lengths for some natural duplexes finds a clear correlation between displacement and length of the underlying thrust sheet, suggesting that this is the environment in which most of the imbricates form. A similar correlation for imbricate active thrust sheets produces a topographic low in a similar position. Further support for the model is provided by the periodic nature of displacement variations. Dissert. Abstr.

N88-29230# Sandia National Labs., Albuquerque, N. Mex.
DEVELOPMENT OF AN ADJUSTABLE BUOYANCY BALLOON TRACER OF ATMOSPHERIC MOTION. PHASE 3: REFINEMENT OF THE OPERATIONAL PROTOTYPE SYSTEM Final Report, Feb. 1986 - Mar. 1988
B. D. Zak and E. W. Lichfield Apr. 1988 149 p Sponsored by EPA, Research Triangle Park, N.C. Prepared in cooperation with Spectra Research Inst., Albuquerque, N. Mex. and Technadyne Engineering Consultants, Inc., Albuquerque, N. Mex.
(PB88-190764; EPA-600/3-88-015) Avail: NTIS HC A07/MF A01 CSCL 04A

The adjustable buoyancy balloon tracer of atmospheric motion is a research tool designed to follow atmospheric flows in both the horizontal and the vertical. The design goals for the tracer balloon specify a lifetime of less than 3 days, tracking range less than 1000 km, ceiling altitude of less than 5.5 km (500 mb), and capability to respond to mean vertical flows as low as 1 cm/s. The accuracies of air pollution transport (trajectory) models, used to establish source receptor relationships, were evaluated to distances of order 1000 km, and the limits on the predictability of source impacts at long distances was assessed. Author

N88-29231*# California Inst. of Tech., Pasadena. Seismological Lab.
INTRAPLATE DEFORMATION, STRESS IN THE LITHOSPHERE AND THE DRIVING MECHANISM FOR PLATE MOTIONS Annual Status Report, 1 Mar. 1987 - 31 Mar. 1988
Bradford H. Hager 1988 42 p

(Grant NAG5-842)
(NASA-CR-183121; NAS 1.26:183121) Avail: NTIS HC A03/MF A01 CSCL 08G

During this period work was carried out on three fronts relevant to the understanding of intraplate deformation, stress in the lithosphere, and the driving mechanisms for plate motions: (1) observational constraints, using GPS geodesy on the deformation in the region of the boundry between the Pacific and North American plates in central and southern California; (2) numerical modeling of the effects of temperature dependent lithospheric viscosity on the stress and strain history of extensional regimes; and (3) improvement of estimates of mantle viscosity variation, the long-wave-length density variations in the mantle, and the topography of the core-mantel boundary from modeling of geoid anomalies, nutation, and changes in length of day. These projects are described in more detail, followed by a discussion of meetings attended and a list of abstracts and papers submitted and/or published. Author

N88-29232# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ACOUSTIC-OPTICAL DETECTOR OF GRAVITATIONAL WAVES BASED ON HIGH-QUALITY CRYSTALS
M. V. Lyablin and D. E. Shabalin 1987 15 p In RUSSIAN; ENGLISH summary
(DE88-702459; JINR-R-13-87-404) Avail: NTIS (US Sales Only) HC A03/MF A01

A design of the detector of gravitational waves based on the optical interferometer with a crystal of high-quality acoustic and optical parameters as a sensitive element is analyzed. The gravitational wave frequency being 10 to the 7th power rad/sec, the maximum Brown noise sensitivity of the detector to the gravitational flux is shown to be able to attain 10 to the -2 to 10 to the -1 erg/sq cm/sec in the frequency band 2 x 10 to the -4 Hz. DOE

N88-29233*# National Aeronautics and Space Administration, Washington, D.C.
PRESENT STATE OF KNOWLEDGE OF THE UPPER ATMOSPHERE 1988: AN ASSESSMENT REPORT
R. T. Watson, M. J. Prather, and M. J. Kurylo Jun. 1988 203 p
(NASA-RP-1208; NAS 1.61:1208) Avail: NTIS HC A10/MF A01 CSCL 04A

This document was issued in response to the Clean Air Act Amendments of 1977, Public Law 95-95, mandating that NASA and other key agencies submit biennial reports to Congress and EPA. NASA is to report on the state of our knowledge of the upper atmosphere, particularly the stratosphere. This is the sixth ozone assessment report submitted to Congress and the concerned regulatory agencies. Part 1 contains an outline of the NASA Upper Atmosphere Research Program and summaries of the research efforts supported during the last two years. An assessment is presented of the state of knowledge as of March 15, 1988 when the Ozone Trends Panel, organized by NASA and co-sponsored by the World Meteorological Organization, NOAA, FAA and the United Nations Environment Program released an executive summary of its findings from a critical in-depth study involving over 100 scientists from 12 countries. Chapter summaries of the International Ozone Trends Panel Report form the major part of this report. Two other sections are Model Predictions of Future Ozone Change and Chemical Kinetics and Photochemical Data for Use in Stratospheric Modeling. Each of these sections and the report in its entirety were peer reviewed. Author

N88-29234*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FORTY-EIGHT-INCH LIDAR AEROSOL MEASUREMENTS TAKEN AT THE LANGLEY RESEARCH CENTER, MAY 1974 TO DECEMBER 1987
W. H. Fuller, Jr., M. T. Osborn, and W. H. Hunt (Wyle Labs., Inc., Hampton, Va.) Oct. 1988 102 p
(NASA-RP-1209; L-16473; NAS 1.61:1209) Avail: NTIS HC A06/MF A01 CSCL 04A

A ground based lidar system located at NASA Langley Research Center in Hampton, Va., was used to obtain high resolution vertical profiles of the stratospheric and upper tropospheric aerosol since 1974. More than 200 measurements obtained at a wavelength of 0.6943 microns during 1974 to 1987 are summarized. Plots of peak backscatter mixing ratio and integrated backscatter vs time are presented for the entire measurement sequence. The plots highlight the influence of several major volcanic eruptions on the long term stratospheric aerosol layer. In particular, the eruptions of El Chichon in late Mar. to early Apr. 1982, produced a massive aerosol layer. Aerosol enhancement from El Chichon reached Hampton, Va. by May 1982, with a scattering ratio of approx. 50 detected on Jul. 1, 1982. In addition, scattering ratio profiles for June 1982 to December 1987, along with tables containing numerical values of the backscatter ratio and backscattering function versus altitude, are included to further describe the upper tropospheric and stratospheric aerosol layer. A 14 year summary is presented, in a ready to use format, of lidar observations at a fixed midlatitude location to be used for further study. Author

N88-29235 California Inst. of Tech., Pasadena.
SEISMIC REFLECTION EXPERIMENTS IMAGING THE PHYSICAL NATURE OF CRUSTAL STRUCTURES IN SOUTHERN CALIFORNIA Ph.D. Thesis
John Nikolai Louie 1987 293 p
Avail: Univ. Microfilms Order No. DA8803405

The analysis of multi-offset seismic reflection data extends the technique beyond its present use as a reconnaissance method. The treatment of multi-offset reflections becomes tractable if the assumptions of high frequency rays are valid for the problem being considered. Their validity can be tested with full wave synthetics. Three studies illustrate the application of these principles to investigations of the nature of the crust in southern California. A survey shot by COCORP across the San Andreas fault near Parkfield revealed events whose arrival time decreased with offset. In 1985 the Calcrust consortium designed a survey in the eastern Mojave desert to image structures in both the shallow and deep crust. Preliminary field experiments showed that the major geophysical acquisition problem to be solved was the poor penetration of seismic energy through a low velocity surface layer. Data obtained from industry showed that basement reflections could be obtained from areas having a deeper sedimentary cover, causing a redefinition of the geologic objective. Long offset stationary arrays provided reverse, wider angle coverage of the deep crust. This dataset and two others from the central and western Mojave was used to constrain the properties of the crust. Multi-offset spectra and amplitude trend stacks of the three Mojave Desert datasets suggest that the most reflective structure in the middle crust are strong Poisson's ratio contrasts. The Moho includes thin layers and an increase in sigma. It maintains the same character across the Mojave despite Miocene extension in the east. Dissert. Abstr.

N88-29236# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
EVALUATION OF ATMOSPHERIC EFFECTS FOR OPERATIONAL TACTICAL DECISION AID Final Report, Jan. - Aug. 1987
Ken Tomiyama 9 Feb. 1988 61 p
(Contract F49620-85-C-0013)
(AD-A194205; AFWAL-TR-87-1190) Avail: NTIS HC A04/MF A01 CSCL 04A

The Tactical Decision Aid (TDA) is an integrated target/atmosphere/sensor model that is used to estimate target acquisition ranges for infrared sensors. It employs an extensive 8000-plus line computer code, LOWTRAN-6, to evaluate the atmospheric extinction of infrared signals for various climatological conditions. The Operational Tactical Decision Aid (OTDA) is a simplified version of the TDA housed on an HP-41CX, a hand-held computer, and is intended for field use. Since LOWTRAN-6 is too voluminous to be employed for the OTDA, precomputed extinction data tables are currently in use. Manual input of data from the

tables to the OTDA is cumbersome and is prone to erroneous readings. Therefore, compact atmospheric extinction models were developed for various types of atmospheric extinction which are significant for the TDA application. The models were developed based on the LOWTRAN-6 computation and were verified through extensive accuracy analysis. For automated generation of a database for accuracy analysis, an interactive driver for LOWTRAN-6, called DGU, was developed. The program can create input decks for LOWTRAN-6 from interactive sessions, run LOWTRAN-6, and post process the LOWTRAN-6 generated data. Finally, the obtained models were integrated into a program, called CTRAN, and coded onto a VAX computer in FORTRAN and in Reverse Polish Notation for the HP-41CX. GRA

N88-29237# Lowell Univ., Mass. Center for Atmospheric Research.
IONOSPHERIC CONVECTION AND STRUCTURE USING GROUND-BASED DIGITAL IONOSONDES Technical Scientific Report No. 1, Aug. 1986 - Jun. 1987
Bodo W. Reinisch, Jurgen Buchau, Edward J. Weber, Leo F. McNamara, and Jane S. Tang Feb. 1988 17 p
(Contract F19628-86-K-0036)
(AD-A194246; ULRF-440/CAR; AFGL-TR-88-0042) Avail: NTIS HC A03/MF A01 CSCL 04A

Ground based digital ionosonde observations of the winter polar cap F region have been used to demonstrate that the magnetospherically induced ionospheric convection can be measured for the bottomside ionosphere. A number of measurements indicate that the drift direction is predominately anti-sunward with speeds that vary between 300 and 900 meters/second. Other measurements show a steady westward drift until local magnetic midnight and then a change to an eastward drift. The ionospheric drifts are consistent with the expected sunward return flows of the two cell polar plasma convection pattern. The utility of data from a network of digital ionosondes is enhanced through automatic scaling of parameters needed for research and radio wave propagation management. The values of hmF2 deduced by real-height analysis of automatically scaled Digisonde ionograms have been compared with simple methods based on routinely scaled ionospheric characteristics. Systematic discrepancies were found between the hmF2 values obtained from the simple methods and the real-height analysis. Overestimates of 15 to 20 km were found for the night data from five stations and low solar activity. Daytime discrepancies are normally less, with 80 percent showing agreement within + or - 10 km. GRA

N88-29238# Naval Postgraduate School, Monterey, Calif.
ATMOSPHERIC ANGULAR MOMENTUM AND LENGTH OF DAY M.S. Thesis
William L. Benedict Mar. 1988 63 p
(AD-A194505) Avail: NTIS HC A04/MF A01 CSCL 04A

Changes in the globally integrated absolute angular momentum of the atmosphere were computed from the Fleet Numerical Oceanography Center NOGAPS wind analyses and compared to astronomically measured changes in length of day (LOD) obtained from the U.S. Naval Observatory, Washington D.C. The two time series were subjected to both time and frequency domain analysis. In the time domain, digital filters were used to isolate seasonal and subseasonal components. In the frequency domain, energy density, coherence and phase were computed over periods from 2 days to 1000 days. Over 90 percent of the total variance in astronomically determined LOD can be explained by meteorological phenomena. Fluctuations in LOD are coherent and in phase with fluctuations in the globally integrated angular momentum of the Earth's shell (crust, mantle and oceans; liquid core is excluded) at almost all periods less than 365 days. Annual fluctuations in LOD appear to originate in the midlatitudes and propagate equatorward. Subseasonal fluctuations (30 to 100 day periods) appear to be a tropical phenomena. GRA

N88-29239# Air Force Geophysics Lab., Hanscom AFB, Mass.
FILLING OF THE ATMOSPHERIC TRANSMISSION WINDOW DUE TO EMISSION FROM VERY HIGH ROTATIONAL LEVELS OF NO AND O3
R. D. Sharma 21 Apr. 1988 13 p Presented at the Background Symposium, Monterey, Calif., Feb. 1988
(AD-A194670; AFGL-TR-88-0110) Avail: NTIS HC A03/MF A01 CSCL 07D

The Quantum-Mechanical Spectator Model or Impulse Approximation (IA) thus far has been used to study the collisions between fast projectiles and targets having little or no internal excitation. It is suggested that IA be applied to collisions of low energy (thermal) projectiles with targets having large internal excitation. This extension is the mechanism proposed for the R-branch bandheads observed in vibration-rotation (V-R) band emission from the high-altitude atmosphere and flow tube laboratory experiments under circumstances which rule out the presence of hot atoms. The implications of V - R transfer for radiance in the atmospheric transmission window are discussed. GRA

N88-29240# Air Force Geophysics Lab., Hanscom AFB, Mass.
WAVE STRUCTURES IN THERMOSPHERIC DENSITY FROM SATELLITE ELECTROSTATIC TRIAXIAL ACCELEROMETER MEASUREMENTS Final Report
4 Jun. 1987 30 p
(AD-A194134; AFGL-TR-87-0189; AFGL-ERP-976) Avail: NTIS HC A03/MF A01 CSCL 04A

Density data from the Satellite Electrostatic Triaxial Accelerometer (SETA) experiment were spectrally analyzed by the Maximum Entropy Method (MEM). The purpose is to make available a technique by which the occurrence of wavelike structures in thermospheric densities can be quantitatively analyzed and correlated with various geophysical conditions, including the deposition of energy at high latitudes during geomagnetically disturbed conditions. Spectra were computed for typical magnetically quiet and active days during July 1983, and the relative occurrence of spectral peaks in wavelength ranges of large-scale (hundreds to thousands of kilometers) and medium-scale (tens to hundreds of kilometers) traveling ionospheric disturbances is examined as a function of local time and latitude. GRA

N88-29241# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Hochfrequenzverfahren.
A MODEL OF THE IONOSPHERE IN THE ALTITUDE INTERVAL 50 TO 4000 KM. PART 1: ATOMIC IONS (H(+), He(+), N(+), O(+))
Walter Koehnlein Feb. 1988 81 p Sponsored in part by Deutsche Forschungsgemeinschaft, Bonn, Fed. Republic of Germany
(DFVLR-FB-88-11-Pt-1; ISSN-0171-1342; ETN-88-92929) Avail: NTIS HC A05/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 28 Deutsche marks

An empirical model of atomic ion densities (H(+), He(+), N(+), O(+)) is presented up to 4000 km altitude as a function of time (diurnal, annual), space (position, altitude) and solar flux (F10.7) using observations of satellites (AE-B, AE-C, AE-D, AE-E, ISIS-2, OGO-6) and rockets during quiet geophysical conditions. The numerical treatment is based upon harmonic functions for the horizontal pattern and cubic splines for the vertical structure. The ion densities increase with increasing height up to a maximum (depending on the ion mass) and decrease beyond that with increasing altitude. Above 200 km, O(+) is the main ionic constituent being replaced at 800 km (depending on latitude, local time, etc.) by H(+). Around polar regions the light ions, H(+) and He(+), are depleted (polar wind) and the heavier ones enhanced. During local summer conditions the ion densities increase around polar latitudes and correspondingly decrease during local winter, except He(+) which reflects the opposite pattern. Diurnal variations are intrinsically coupled to the individual plasma layers: N(+) and O(+) peak during daytime, while the amplitudes and phases of H(+) and He(+) change strongly with altitude and latitude. ESA

N88-29242# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Hochfrequenzverfahren.
A MODEL OF THE IONOSPHERE IN THE ALTITUDE INTERVAL 50 TO 4000 KM. PART 2: MOLECULAR IONS (N2(+), NO(+), O2(+)) AND ELECTRON DENSITY
Walter Koehnlein Feb. 1988 85 p Sponsored in part by Deutsche Forschungsgemeinschaft, Bonn, Fed. Republic of Germany
(DFVLR-FB-88-12-Pt-2; ISSN-0171-1342; ETN-88-92930) Avail: NTIS HC A05/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 29 Deutsche marks

Empirical models of molecular ion densities (N2(+), NO(+), O2(+)) and the electron density (Ne) are presented in the altitude interval 50 to 4000 km as functions of time (diurnal, annual), space (position, altitude) and solar flux (F10.7). Using observations of 6 satellites (AE-C, AE-D, AE-E, ALOUETTE-2, ISIS-1, ISIS-2), 4 incoherent scatter stations and more than 700 D-region profiles, this model describes the global gross features of the ionosphere for quiet geophysical conditions. The molecular ion densities and the electron density increase with increasing altitude up to a maximum (or several maxima) and decrease from thereon with increasing height. Between 80 and 200 km, the main ionic constituents are NO(+) and O2(+); below 80 km cluster ions predominate. During local summer conditions the molecular ions and Ne increase around polar latitudes and decrease correspondingly during local winter. The diurnal variations are intrinsically coupled to the individual plasma layers; molecular ion and electron densities are enhanced during daytime and depleted during nighttime. ESA

N88-29243 Institut d'Aeronomie Spatiale de Belgique, Brussels.
EUROPEAN VALIDATION OF SAGE-2 AEROSOL PROFILES
M. Ackerman, C. Brogniez, G. Fiocco, P. Gobbi, M. Herman, M. Jaeger, J. Lenoble, C. Lippens, G. Megie, and J. Pelon et al. 1988 50 p Submitted for publication
(Aeronomica-Acta-A-327-1988; ISSN-0065-3713; ETN-88-92723) Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

A SAGE-2 validation program was performed using ground based lidars and balloon-borne polarimetric and photographic experiments. Between the tropopause height and 23 km, good agreement is found between the SAGE-2 1.02 micron extinction profiles and the lidar profiles, using for the conversion of backscattering into extinction an aerosol model consistent with the SAGE-2 spectral extinction. The extinction profiles deduced from the limb photographs at 0.44 and 0.375 microns present a good agreement with the SAGE-2 profiles respectively at 0.453 and 0.385 microns. The size distribution retrieved from the near infrared polarimetric observations leads to a spectral variation of the extinction in good agreement with SAGE-2 data, in the same altitude range. Above 23 to 25 km, observations are scarce and the data of poorer quality because of the low aerosol content. The 1.02 micron extinction profiles seem to agree with the ruby lidar and the limb photographs profiles. But any conclusion concerning the short wavelength profiles and the size distribution at this high altitudes is risky. ESA

N88-29244# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
SNAPSHOTS OF HIGH-LATITUDE ELECTRODYNAMICS USING VIKING AND DMSP/F7 OBSERVATIONS
G. T. Marklund, L. G. Blomberg, K. Stasiewicz, J. S. Murphree, R. Pottelette, L. J. Zanetti, T. A. Potemra, D. A. Hardy, and F. J. Rich (Air Force Geophysics Lab., Hanscom AFB, Mass.) Feb. 1988 28 p Sponsored by the Swedish Board for Space Activities, Stockholm, Sweden
(TRITA-EPP-88-01; ISSN-0348-7539; ETN-88-92811) Avail: NTIS HC A03/MF A01

Simultaneous observations by the Viking and the DMSP/F7 satellites were used to obtain snapshot pictures of the auroral electrodynamics. An instantaneous global equipotential (or convection) pattern is calculated using field-aligned current and conductivity distributions that are qualitatively consistent with the Viking auroral imager data and quantitatively consistent with magnetic field and particle data from the two satellites. This convection pattern which is of the normal two-cell type, with a weak dusk cell and a strong, elongated crescent-shaped dawn cell (consistent with positive IMF By) agrees well with the Viking electric field data. The model and the observed potential profiles agree along the entire Viking orbit except for two intervals above acceleration regions where deviations are to be expected. Model results are thus consistent with the Viking observations on a global and on the scale size of the auroral acceleration regions. The corresponding convection in the magnetosphere is illustrated by a simple projection of the deduced two-cell convection pattern to the equatorial plane. From this the instantaneous location of the plasmapause is inferred. ESA

N88-29245# European Space Agency, Paris (France).
INVESTIGATIONS ON THE ENTROPY OF CLOUDY AIR
Thomas Hauf and Julius Weidner Jul. 1988 152 p Transl. into ENGLISH of Untersuchungen zur Entropie der Wolkenluft, Oberpfaffenhofen, Federal Rep. of Germany (DFVLR) Original language document was announced as N87-26478
(ESA-TT-1060; DFVLR-FB-86-51; ETN-88-93049) Avail: NTIS HC A08/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 46 deutsche marks

Thermodynamics and statistical mechanics facts concerning the entropy of cloudy air were included in a method which uses entropy as a prediction parameter in an atmospheric flow model. The entropy state function, and the statistical interpretation of entropy are presented. The dependence of entropy on pressure, temperature, and concentrations, and the entropy budget are discussed. ESA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-29246# Naval Postgraduate School, Monterey, Calif.
INTERACTIONS BETWEEN SYNOPTIC AND PLANATERY SCALES OF MOTION Ph.D. Thesis
Michael D. McAtee Dec. 1987 123 p
(AD-A192328; AD-E801594) Avail: NTIS HC A06/MF A01 CSCL 04B

The effects of synoptic waves on the dynamics of planetary waves are investigated using normal mode analysis. Initialized analyses of the Navy Operational Global Atmospheric Prediction System (NOGAPS) for 19 days between January and April 1986 are projected onto the normal modes of a linearized version of the model. For each analysis, the different terms (adiabatic nonlinear, linear and diabatic) which affect the time tendency of planetary-scale modes are determined by a one-time step integration of the NOGAPS model. The effect of synoptic scales on planetary scales is determined by computing the difference between the adiabatic nonlinear term computed from the NOGAPS analyzes and analyzes for the same period that have been spectrally filtered to remove most of the synoptic-scale waves. GRA

N88-29247# Sandia National Labs., Albuquerque, N. Mex.
A COMPARISON OF TYPICAL METEOROLOGICAL YEAR SOLAR RADIATION INFORMATION WITH THE SOLMET DATA BASE
D. F. Menicucci and J. P. Fernandez Feb. 1988 406 p
(Contract DE-AC04-76DP-00789)
(DE88-009242; SAND-87-2379) Avail: NTIS HC A16

Over the years the misapplication of TMY and SOLMET data has become increasingly prevalent and, in some cases, has led to improperly sized solar energy systems or incorrect conclusions from research efforts. Much of the misapplication stems from misunderstanding and confusion about the origin, design and originally intended uses of these data. This report outlines the

historical development of the SOLMET and TMY data bases and discusses the various appropriate applications for them. A majority of the report is devoted to the presentation of summary solar radiation information about the SOLMET data base and associated TMY data. Solar resource summary statistics are computed for direct normal, total normal, and fixed tilt collectors at thirty-eight sites. For each site, statistical information is presented in graphical and tabular form and can be used to compare the representative TMY year to each SOLMET year. This report is specifically intended for individuals who use TMY and/or SOLMET solar radiation data in some aspect of solar system design, analysis, or operation and want information about the potential yearly variation of the solar resource in various locations throughout the United States. DOE

N88-29248# Lawrence Livermore National Lab., Calif.
REGIONAL INTERCOMPARISONS OF GENERAL CIRCULATION MODEL PREDICTIONS AND HISTORICAL CLIMATE DATA: CO2
S. L. Grotch Apr. 1988 307 p
(Contract W-7405-eng-48)
(DE88-010416; DOE/NBB-0084) Avail: NTIS HC A14/MF A01

This study is a detailed intercomparison of the results produced by four different General Circulation Models (GCMs) used to project the climatic consequences of a doubling of the atmospheric CO2 concentration. The results for the models developed by groups at the National Center for Atmospheric Research, the Geophysical Fluid Dynamics Laboratory of NOAA, and the Goddard Institute for Space Studies of NASA have been described by Schlesinger and Mitchell (1985) in the DOE state-of-art (SOA) report, Projecting the Climatic Effects of Increasing Carbon Dioxide. The fourth model examined here is the Oregon State University GCM, results for which did not become available until after publication of the SOA. We have chosen to examine only two model variables here: (1) surface air temperature, and (2) precipitation. We consider these variables for both seasonally and annually averaged periods, for both the current climatic conditions and the predicted equilibrium changes after a doubling of the CO2 concentration. The major conclusion is that, although the models often agree well comparing seasonal or annual averages over the large areas, substantial disagreements become apparent as the spatial extent is reduced, particularly when detailed regional distributions are examined. At scales below continental, the correlations observed between different model predictions are often very poor, particularly for land gridpoints during the Northern Hemisphere (NH) summer, with differences of as much as 5 C between models and observations and between one model and another over relatively large areas. DOE

N88-29249# RAND Corp., Santa Monica, Calif.
TYPICAL WEATHER MONTHS IN THE PAST (1973-1983) IN CENTRAL EUROPE Interim Report
Ralph E. Huschke Mar. 1988 37 p
(Contract F49620-86-C-0008)
(AD-A194701; RAND/N-2457-AF) Avail: NTIS HC A03/MF A01 CSCL 04B

RAND is currently upgrading its capability to handle the effects of weather and weather information in air and land combat simulations. The objective is to allow real weather to influence operations and realistically uncertain forecasts of the real weather to influence decisions. This requires designing a weather module that incorporates weather data, effects, and forecasts, and is compatible with the family of C3 and warfare models that will exist in RAND's new Military Operational Simulation Facility. This activity has four phases: (1) Structuring historical data on a space-time grid; (2) Determining periods of typical weather; (3) Developing weather forecast algorithms; (4) Developing weather-effects algorithms for both air and land operations. This note documents historical periods of central European weather that reliably typify average weather conditions for any chosen season. It also identifies worst case and best case weather periods that can be used to establish weather bounds on results of air-land battle simulations. GRA

N88-29250# Naval Postgraduate School, Monterey, Calif.
AN OBJECTIVE TECHNIQUE FOR ARCTIC CLOUD ANALYSIS USING MULTISPECTRAL AVHRR (ADVANCED VERY HIGH RESOLUTION RADIOMETER) SATELLITE IMAGERY M.S. Thesis
John P. Barron Mar. 1988 81 p Original contains color illustrations
(AD-A194732) Avail: NTIS HC A05/MF A01 CSCL 04B

An established cloud analysis routine has been modified for use in the Arctic. The separation of clouds from the snow and sea ice backgrounds is accomplished through a multispectral technique which utilizes very high resolution radiometer (VHRR) channel 2 (visible), channel 3 (near infrared) and channel 4 (infrared) data. The primary means of cloud identification is based on a derived channel 3 reflectance image. At this wavelength, a significant contrast exists between liquid clouds and the arctic backgrounds, unlike in the standard visible and infrared images. The channel 3 reflectance is obtained by first using the channel 4 emission temperature to estimate the thermal emission component of the total channel 3 radiance. This thermal emission component is subsequently removed from the total radiance, leaving only the solar reflectance component available for analysis. Since many ice clouds do not exhibit a substantially greater reflectance than channel 3, the routine exploits differences in transmissive characteristics between channels 3 and 4 for identification. The routine was applied to six case studies which had been analyzed by three independent experts to establish ground truth. Verification of the cloud analysis results, through a comparison to the subjective analyses, yielded impressive statistics. GRA

N88-29251# Naval Postgraduate School, Monterey, Calif.
METEOROLOGICAL FEATURES DURING THE MARGINAL ICE ZONE EXPERIMENT FROM 20 MARCH TO 10 APRIL 1987 M.S. Thesis
Ryan R. Schultz Dec. 1987 86 p
(AD-A193960) Avail: NTIS HC A05/MF A01 CSCL 04B

Described are synoptic and mesoscale meteorological conditions which occurred in the marginal ice zone (MIZ) of the Greenland sea (Fram Strait). Measurements were made from three ships and weather analysis and ice edge location analysis were provided by shore meteorological support at Tromso, Norway. MIZEX 1987 is separated into five periods with distinct meteorological conditions. In the first period, from 20 to 23 March, the MIZ region was dominated by a large scale surface high pressure system. During the second period, from 24 to 27 March, a mesoscale boundary-layer front dominated the MIZ. This front was the object of a more detailed case study. During the third period, from 28 to 31 March, a weak surface synoptic-scale low pressure system dominated the MIZ. During the fourth period, from 1 to 3 April, a low developed 100 km east of Greenland and subsequently moved to the east, filling when it reached central Norway. During the fifth and final period, from 4 to 10 April, two lows developed 100 km north of Iceland which traveled northeastward along the classic secondary climatological storm track to a position 100 km southwest of the Svalbord Islands. When the first low of this fifth period stalled and was overtaken by the second low of this fifth period a combined and considerably enhanced system developed which extended along the west coast of the Svalbard Islands to the Norwegian Sea. All described features appeared clearly on NOAA 9 and 10 imagery. GRA

N88-29252# International Centre for Theoretical Physics, Trieste (Italy).
GLOBAL SOLAR RADIATION IN SIERRA LEONE (WEST AFRICA)
J. G.M. Massaquoi Sep. 1987 9 p
(DE88-702725; IC-87/334) Avail: NTIS (US Sales Only) HC A02/MF A01

A correlation equation of the Angstrom type has been developed to predict the monthly average daily global solar irradiation incident on a horizontal surface in Freetown, Sierra Leone. Measurements of the global insolation have been compared with those predicted

using the equation. A good agreement (greater than 95 percent in most cases) was observed between the measured values and the predicted ones. DOE

N88-29253# International Centre for Theoretical Physics, Trieste (Italy).
MATHEMATICAL CORRELATION BETWEEN VARIATIONS IN SOLAR RADIATION PARAMETERS. PART 1: DAILY SUMS OF GLOBAL RADIATION AND MIDDAY GLOBAL RADIATION
E. C. Njau Nov. 1987 13 p
(DE88-702742; IC-87/363) Avail: NTIS (US Sales Only) HC A03/MF A01

An equation that simply relates variations in the daily sums of global radiation and the corresponding midday global radiation data over an arbitrarily chosen location on the Earth is derived from first principles. Although this equation is specifically tailored for periods incorporating only cloudless days, it is modified slightly in order also to suit any period that incorporates either cloudless days or consistently cloudy days or days characterized by consistently distributed cloud patches or any combination of these. Global radiation data for Dar es Salaam, Tanzania, calculated on the basis of the slightly modified version of the equation mentioned above agree with actual measurements to at least 89 percent if each of the days involved is either fairly cloudless or consistently cloudy or is characterized by fairly consistent cloud patches from sunrise to sunset. This clearly demonstrates that it is quite possible to work out reasonable estimates of the overall global radiation incident on a given area using only the corresponding midday global radiation data for that particular area. DOE

N88-29254# International Centre for Theoretical Physics, Trieste (Italy).
BASIC CAUSES OF AMPLITUDE MODULATION IN CLIMATIC/WEATHER PARAMETERS
E. C. Njau Nov. 1987 21 p
(DE88-702743; IC-87/364) Avail: NTIS (US Sales Only) HC A03/MF A01

The continuous interaction between the Earth's spinning motion and energy from the Sun gives rise to some (heat) energy oscillations in the Earth-atmosphere system (Njau, 1985a; 1985b; 1986a; 1986b). Recent results of large scale analysis of East African climatic records have proved that these oscillations significantly link the Sun to climatic/weather variations by systematically modulating key climatic/weather parameters like rainfall and air temperature (Njau, 1987a; 1987b; 1987c; 1987e; 1987f). In this paper, we re-develop the latter proof using a very different approach based upon theoretical analysis. The analysis has confirmed a general law suggested earlier (Njau, 1987d), that, with an exception of the diurnal cycle, any permanent cycle in the net solar energy incident upon a given part of the Earth-Atmosphere system gives rise to a quasi-permanent cycle whose period is approximately twice that of the former. Quasi-biennial as well as double sunspot cycles are shown to be a possible result of this general law. DOE

N88-29255# European Space Agency, Paris (France).
ON EXPERIENCES WITH TWO HOT-WIRE INSTRUMENTS FOR MEASURING THE LIQUID WATER CONTENT IN CLOUDS
Hans-Eberhard Hoffmann (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany), Johann Demmel, and Heinz Loebel Jun. 1988 43 p Transl. into ENGLISH of Ueber Erfahrengen zwei Hitzdrahtinstrumenten zur Messung des Fluessigwassergehalts von Wolken, Oberpfaffenhofe, Federal Rep. of West Germany (DFVLR) Original language document was announced as N87-26476
(ESA-TT-1085; DFVLR-Mitt-86-18; ETN-88-92911) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 16.50 deutsche marks

The results of airborne measurements of liquid water content using two hot-wire instruments: the Johnson-Williams (JW) and the Csiro-King (CK) instruments are discussed. Results are very consistent within the 0.04 to 0.46 g/cu m range, subject to correct dry-air calibration and to the exclusion of systematic errors. The dry-air values of the JW instrument are not (or only slightly) affected by variations in airspeed, height, and temperature, while those of the CK instrument are markedly affected. Radio signals have a very noticeable influence on the CK signals. In both instruments, atmospheric turbulence and banking maneuvers produce similar signals to those produced by the liquid water content. In the case of the CK instrument, it is not possible to achieve sufficient accuracy in transferring wind tunnel calibration data to flight measurements. ESA

N88-29256*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WIND MEASUREMENTS BY ELECTROMAGNETIC PROBES
Michael Susko Sep. 1988 30 p
(NASA-TM-4066; NAS 1.15:4066) Avail: NTIS HC A03/MF A01 CSCL 04B

The emerging technology of electromagnetic probing of the atmosphere to measure winds used in a space vehicle ascent winds load calculations is presented. The frequency range, altitude, and resolution for the following probes are presented: lidars, microwave radars, and clear-air Doppler radars (popularly known as wind profilers). The electromagnetic probing of the atmosphere by clear-air radars and lasers is the new technology to supplement balloon-borne wind sensors used to determine ascent wind loads of space vehicles. The electromagnetic probes measure the wind velocity using the Doppler effect. This is the radar technology used in MSFC's Radar Wind Profiler, and is similar to the technology used in conventional Doppler systems except that the frequency is generally lower, antenna is bigger, and dwell time much longer. Designed for unattended and automated instrumentation in providing measurements of the wind in the troposphere, the profiler employs Doppler radar technology and is currently being put in operation at NASA Kennedy Space Center, Florida. Author

N88-29257*# Old Dominion Univ., Norfolk, Va. Dept. of Electrical and Computer Engineering.
AIRBORNE RADAR TECHNOLOGY FOR WINDSHEAR DETECTION Final Report, period ending 31 Aug. 1988
Joseph L. Hibey and Camille S. Khalaf Jul. 1988 45 p
(Grant NAG1-626)
(NASA-CR-183203; NAS 1.26:183203) Avail: NTIS HC A03/MF A01 CSCL 04B

The objectives and accomplishments of the two-and-a-half year effort to describe how returns from on-board Doppler radar are to be used to detect the presence of a wind shear are reported. The problem is modeled as one of first passage in terms of state variables, the state estimates are generated by a bank of extended Kalman filters working in parallel, and the decision strategy involves the use of a voting algorithm for a series of likelihood ratio tests. The performance issue for filtering is addressed in terms of error-covariance reduction and filter divergence, and the performance issue for detection is addressed in terms of using a probability measure transformation to derive theoretical expressions for the error probabilities of a false alarm and a miss. Author

N88-29258*# Electro Magnetic Applications, Inc., Denver, Colo.
INVESTIGATIONS INTO THE TRIGGERED LIGHTNING RESPONSE OF THE F106B THUNDERSTORM RESEARCH AIRCRAFT
Terence H. Rudolph, Rodney A. Perala, Paul M. McKenna, and Steven L. Parker Washington, D.C. Jun. 1985 215 p
(Contract NAS1-16984)
(NASA-CR-3902; NAS 1.26:3902; EMA-85-R-02) Avail: NTIS HC A10/MF A01 CSCL 04B

An investigation has been conducted into the lightning characteristics of the NASA F106B thunderstorm research aircraft. The investigation includes analysis of measured data from the aircraft in the time and frequency domains. Linear and nonlinear computer modelling has also been performed. In addition, new computer tools have been developed, including a new enhanced nonlinear air breakdown model, and a subgrid model useful for

analyzing fine details of the aircraft's geometry. Comparison of measured and calculated electromagnetic responses of the aircraft to a triggered lightning environment are presented. Author

N88-29259*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 1983 DIRECT STRIKE LIGHTNING DATA, PART 1
Mitchel E. Thomas Washington, D.C. Aug. 1985 439 p
(NASA-TM-86426-Pt-1; NAS 1.15:86426-Pt-1) Avail: NTIS HC A19/MF A01 CSCL 04B

Data waveforms are presented which were obtained during the 1983 direct strike lightning tests utilizing the NASA F106-B aircraft specially instrumented for lightning electromagnetic measurements. The aircraft was operated in the vicinity of the NASA Langley Research Center, Hampton, Virginia, in a thunderstorm environment to elicit strikes. Electromagnetic field data and conduction currents on the aircraft were recorded for attached lightning. Part 1 contains 435 pages of lightning strike data in chart form. Author

N88-29260*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 1983 DIRECT STRIKE LIGHTNING DATA, PART 2
Mitchel E. Thomas Washington, D.C. Aug. 1985 447 p
(NASA-TM-86426-Pt-2; NAS 1.15:86426-Pt-2) Avail: NTIS HC A19/MF A01 CSCL 04B

Data waveforms are presented which were obtained during the 1983 direct strike lightning tests utilizing the NASA F106-B aircraft specially instrumented for lightning electromagnetic measurements. The aircraft was operated in the vicinity of the NASA Langley Research Center, Hampton, Virginia, in a thunderstorm environment to elicit strikes. Electromagnetic field data and conduction currents on the aircraft were recorded for attached lightning. Part 2 contains 443 pages of lightning strike data in chart form. Author

N88-29261*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 1983 DIRECT STRIKE LIGHTNING DATA, PART 3
Mitchel E. Thomas Washington, D.C. Aug. 1985 450 p
(NASA-TM-86426-Pt-3; NAS 1.15:86426-Pt-3) Avail: NTIS HC A19/MF A01 CSCL 04B

Data waveforms are presented which were obtained during the 1983 direct strike lightning tests utilizing the NASA F106-B aircraft specially instrumented for lightning electromagnetic measurements. The aircraft was operated in the vicinity of the NASA Langley Research Center, Hampton, Virginia, in a thunderstorm environment to elicit strikes. Electromagnetic field data and conduction currents on the aircraft were recorded for attached lightning. Part 3 contains 446 pages of charts depicting additional lightning strike data. Author

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-29262# Science Applications International Corp., College Station, Tex. Applied Environmental Sciences Div.
SEA ICE PROCESSES Final Report, 1 Jan. 1987 - 1 Jan. 1988
James K. Lewis, Maria R. Giuffrida, and Warren W. Denner Jan. 1988 22 p
(Contract N00014-87-C-0173; Proj. R12-99)
(AD-A193980; SAIC-87/1870) Avail: NTIS HC A03/MF A01 CSCL 08L

This report documents the results of a study of a number of sea ice processes in the Arctic Basin. Seasonal sea ice kinematics were closely scrutinized, and their space and time scales calculated. In addition, factors concerning sea ice thermodynamics were considered. Finally, direct comparisons were made between observed ice velocities and corresponding ice velocities from the Polar Ice Prediction System (PIPS). One of the primary objectives of this work was to provide a wide range of information with which one could validate the mechanics and predictions of the PIPS. Factors that were studied include the grid size and time step of the PIPS, the scale of important forcing variables, the formulation of heat fluxes within the model ice field, and steps to be considered in the attempt to produce the most realistic predictions possible. GRA

51 LIFE SCIENCES (GENERAL)

N88-29263# Centers for Disease Control, Atlanta, Ga.
QUALITY CONTROL IN MICROBIOLOGY: CDC LAB MANUAL
J. M. Miller Nov. 1987 106 p
(PB88-179890) Avail: NTIS HC A06/MF A01 CSCL 06C

A brief historical background is given for procedural technology in the laboratory. The topic headings are: Quality control in the microbiology laboratory; Introduction; Establishing a quality control policy; Laboratory safety; Equipment; Media, Reagents, Disks, Strips; Products for direct antigen detection; Documentation; Antisera disk/strips, Reagents-Aerobic bacteriology; Quality control frequency guidelines for antimicrobic susceptibility testing; Media-anaerobic bacteriology; Mycobacteriology. Author

N88-29264# Nebraska Univ., Lincoln. Dept. of Chemistry.
ELECTROCHEMICAL AND OPTICAL STUDIES OF MODEL PHOTOSYNTHETIC SYSTEMS Progress Report, 1 Jul. 1987 - 30 Jun. 1988
T. M. Cotton 15 Feb. 1988 6 p
(Contract DE-FG02-84ER-13261)
(DE88-009291; DOE/ER-13261/2) Avail: NTIS HC A02/MF A01

During the first eight months of this funding period, we have continued our studies of photosynthetic model systems using Langmuir-Blodgett monolayers, self-assembled monolayers, and vesicles. These model systems were characterized by electrochemical and optical methods (resonance Raman, UV-Vis, and surface-enhanced resonance Raman scattering (SERRS) spectroscopy). A number of different redox-active molecules were examined in addition to the natural photosynthetic pigments. A brief summary of the results is discussed. DOE

N88-29265# School of Aerospace Medicine, Brooks AFB, Tex.
USAF HYPERBARIC ANIMAL TRANSFER CHAMBER SYSTEM Final Report, Aug. 1986 - Feb. 1987
Rocky D. Calcote Jan. 1988 90 p
(AD-A193633; USAFSAM-TR-87-9) Avail: NTIS HC A05/MF A01 CSCL 13G

The Animal Transfer Chamber (ATC) is an especially designed and constructed test system for research use in the study and evaluation of the physiological effects of high barometric pressures on laboratory animals. The purpose of this technical report is to provide the user organization with guidance, procedures, and safety precautions related to the installation and operation of the USAF hyperbaric ATC system. GRA

N88-29266# Army Research Inst. of Environmental Medicine, Natick, Mass.
LOW DOSES OF ATROPINE SULFATE IMPAIR RETENTION OF A WELL-LEARNED SPATIAL TASK
T. M. Bauch, D. I. Welch, and L. Gallego Apr. 1988 21 p
(AD-A194065) Avail: NTIS HC A03/MF A01 CSCL 05H

Retention of a well-learned spatial task was assessed in rats 10 minutes prior to, and 10, 20, 30, 40 and 50 minutes after treatment with 3, 10 or 30 mg/kg, iv, atropine sulfate or the equivalent volume of saline, iv. There was a variable dose effect for escape latency and choice accuracy measures of spatial retention. A relatively large dose of atropine sulfate (30 mg/kg, iv) significantly impaired choice accuracy and escape latency

compared with the control group. Moreover, impairment in choice accuracy was observed with the control group. Moreover, impairment in choice accuracy was observed with smaller doses of atropine sulfate (3, 10 mg/kg, iv) than have previously been shown to disrupt spatial retention. GRA

N88-29267# Dartmouth Coll., Hanover, N.H. Medical School.
EMETIC MECHANISM IN ACUTE RADIATION SICKNESS Technical Report, 1 Dec. 1982 - 30 Nov. 1986
Herbert L. Borison 20 Aug. 1987 58 p
(Contract DNA001-83-C-0010; DNA Proj. U99-QMXM)
(AD-A194102; DNA-TR-87-159) Avail: NTIS HC A04/MF A01 CSCL 06G

A dose-response relationship was established in normal cats for the evocation of vomiting within 24 h after whole-body exposure to 60 Co radiation with doses ranging from 7.5 to 60 Gy delivered at 1.0 Gy/min. Vomiting was recorded oscillographically. Radiation-induced vomiting was elicited unabatedly at the optimal dose of 45 Gy in chronically postremectomized cats. Radioemetic susceptibility was evaluated in normal cats after each of two doses of radiation, from 7.5 to 60 Gy, given on successive days. Occurrence of radioemetic protection against the second irradiation was manifested in direct relation to the magnitude of the first exposure, and complete protection for 24 h resulted after second radiation exposure at the highest dose level. Postremectomized cats were also fully protected against the radioemetic effect of a second exposure at 45 Gy. All normal cats vomited in response to an emetic drug injection during the state of radioemetic refractoriness after the second irradiation at 45 Gy. A neural origin of emetic signal generated by first radiation exposure was examined in postrema-intact cats. GRA

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-29268# Utah Univ., Salt Lake City.
CURRENTS INDUCED IN A HUMAN BEING FOR ELECTROMAGNETIC FIELDS TO 10 kHz-50 MHz Final Report
Om P. Gandhi 15 Jan. 1988 52 p
(Contract N00014-86-K-01014)
(AD-A191977; ETL-88002-TR) Avail: NTIS HC A04/MF A01 CSCL 06J

The two tasks undertaken during the period of this project are: (1) Development of a high resolution thermal model of the human leg and its use to estimate the temperature distribution as a result of the induced high current densities at radio frequencies. (2) Development of a high-resolution, anatomically-realistic, inhomogeneous model of man and its use to calculate the SAR and induced current distributions for frequencies to 100 MHz. We have previously shown (1,2) that vertically polarized incident plane waves are capable of inducing fairly significant RF currents in a free-standing human being. Foot currents were found to be proportional to the frequency of incident radiation for the frequency band 0 to 40 MHz with values as high as 12.7 milli A/(V/m) measured for adult human volunteers at 40 MHz. Recognizing that the induced current is divided equally between the two legs on its way to the ground underneath, fairly high current densities result in the various cross sections of the leg with concommitant high rates of energy deposition (SAR). In particular, due to the predominantly bony nature of the ankle cross section forcing the RF current to flow in an effective 9.5 sq cm cross section of the high conductivity tissues, very high current densities (J) and the resulting SARs are set up. These SARs are almost two orders of magnitude larger than the metabolic rates of the tissues and considerably in excess of the ANSI guideline of 8 W/kg for any 1 g of tissue. Author

N88-29269 Connecticut Univ., Storrs.
HUMAN AUDITORY AND VISUAL CONTINUOUS EVOKED POTENTIALS Ph.D. Thesis
Zvi Z. Goldman 1987 192 p
Avail: Univ. Microfilms Order No. DA8800222

The motivation for this research was to develop an evoked potential methodology for non-invasively monitoring the auditory and visual sensory channel engagement and interaction (A x V) in humans. Sensory interaction was concluded whenever response variations of one sensory channel could be attributed to parameter changes of an additional stimulus, simultaneously presented to another sensory channel. This study adapted the phase-lock technique in characterizing the stimulus parameter-space of the A x V process. Dissert. Abstr.

N88-29270# Army Research Inst. of Environmental Medicine, Natick, Mass.
HUMAN PERFORMANCE AND ACUTE HYPOXIA, CHAPTER 12
Charles S. Fulco and Allen Cymerman Nov. 1987 52 p
(AD-A192604; USARIEM-M-11/88) Avail: NTIS HC A04/MF A01 CSCL 06E

The effects of a reduction in ambient oxygen pressure occurring within four hours are dependent to a large extent on one principal factor: the degree of hypoxia and the resultant arterial hypoxemia. As the degree of hypoxia increases, a series of compensatory responses occur in various organ systems which are directly proportional to the severity. Above approximately 1500 m, demonstrable changes become evident in ventilation, cardiac output, circulation, blood endocrine levels, and sensory and mental function. With a level of hypoxia equivalent to approximately 4000 m, the changes can become considerable and can be discerned for almost any physiological and psychological function. The problems are further accentuated when exercise is superimposed on the hypoxia. With physical performance, reductions of both maximal and endurance exercise capacity are observed almost immediately due to the reduction in oxygen content of arterial blood despite potentially beneficial changes in alveolar ventilation, distribution of ventilation/perfusion ratios, cardiac output distribution, shifts in the oxygen dissociation curve, increases in sympathetic nervous system activity, and changes in fluid control hormones. GRA

N88-29271# Army Research Inst. of Environmental Medicine, Natick, Mass.
EFFECTS OF PSYCHOPHYSICAL LIFTING TRAINING ON MAXIMAL REPETITIVE LIFTING CAPACITY Report, Feb.-May 1985
M. A. Sharp and S. J. Legg Dec. 1987 28 p
(DA Proj. 3E1-62787-A-879)
(AD-A192605; USARIEM-M-12/88) Avail: NTIS HC A03/MF A01 CSCL 06J

The purpose of this investigation was to determine the effectiveness of psychophysical lifting training on maximal repetitive lifting capacity. Maximal repetitive lifting capacity was defined as the maximum box mass that could be lifted for a full hour to a height of 132 cm at a rate of 6 lifts per minute. Eight male subjects participated in five psychophysical lifting training sessions each week for four weeks. Each day subjects were presented one empty and one heavily loaded box and asked to adjust to the maximum load they felt capable of lifting for one hour. This load was lifted at a rate of 6 lifts per minute to a height of 132 cm for two 15 minute sessions. After four weeks of training, subjects did not select a heavier training load, exhibit a decreased training heart rate, or report a decreased training RPE. The training program produced a significant increase in one hour maximal repetitive lifting capacity. The box mass selected for the maximal repetitive lifting capacity test increased significantly following training, with no concomitant change in VO2, heart rate or RPE. GRA

N88-29272# Army Research Inst. of Environmental Medicine, Natick, Mass.
ALTERATIONS IN UPPER EXTREMITY MOTOR FUNCTION IN SOLDIERS DURING ACUTE HIGH ALTITUDE EXPOSURE
Allan J. Hamilton, Laurie A. Trad, and Allen Cymerman Mar.

1988 31 p
(AD-A192676; USARIEM-M-31/88) Avail: NTIS HC A03/MF A01 CSCL 06E

Acute Mountain Sickness (AMS) is a syndrome of inadequate acclimatization to the diminished concentration of oxygen available at high altitude. In its mild form, it is almost solely a symptomatic illness and physical examination is usually unremarkable. We hypothesized that while clinical examination might be insensitive for the detection of quantifiable changes, computerized measures of neurological function could be capable of noninvasively measuring and analyzing decrements in neurological function at high altitude. For this reason, a device was designed and tested called an upper extremity movement analyzer (UEMA) which employs magnetic coil search technology to record movements of a subject's upper extremity. Software programs were developed which analyze the recorded movements of a pen stylus between a common start position and a randomly generated series of target positions on the digitizing tablet. Subjects were first tested at SL and then at 18 hrs and 30 hrs. Clinical assessments, neurological examinations, and environmental symptoms questionnaires (ESQ) were performed serially to compare with UEMA. GRA

N88-29273# Yale Univ., New Haven, Conn. School of Medicine.
LIMITS OF PATTERN DISCRIMINATION IN HUMAN VISION Annual Technical Report, 1 Jan. 1987 - 1 Jan. 1988
Joy Hirsch 1 Jan. 1988 14 p
(Grant AF-AFOSR-0077-86)
(AD-A193449; AFOSR-88-0375TR) Avail: NTIS HC A03/MF A01 CSCL 06D

The three specific aims of this current ongoing project include: (1) the characterization of the human and monkey photoreceptor lattice; (2) the study of new spatial discriminations in two dimensions including circle center, area, and dot density discriminations, and (3) the expansion and generalization of current models of one-dimensional spatial discriminations such as spatial-frequency, line separation, and vernier acuity. GRA

N88-29274# Army Research Inst. of Environmental Medicine, Natick, Mass.
ATTITUDES TOWARDS THE COLD: EFFECTS ON PSYCHOLOGICAL MOOD AND SUBJECTIVE REPORTS OF ILLNESS DURING COLD WEATHER TRAINING
Richard F. Johnson, Laurence G. Branch, and Donna J. McMenemy Feb. 1988 33 p
(AD-A194777; USARIEM-T-11/88) Avail: NTIS HC A03/MF A01 CSCL 05H

The present study examined the influence of soldiers' attitudes toward the cold, expectations concerning living and working in the cold, and subjective reports of psychological stress on subsequent symptoms of physical illness and psychological mood during military training in the cold. GRA

N88-29275# New York Univ., New York. Neuromagnetism Lab.
CRYOSQUID: A SQUID-BASED MAGNETIC FIELD SENSOR Final Technical Report No. 3, 15 Aug. 1984 - 30 Nov. 1987
S. J. Williamson and Lloyd Kaufman 15 Mar. 1988 16 p
(Grant AF-AFOSR-0313-84)
(AD-A194237; AFOSR-88-0461TR) Avail: NTIS HC A03/MF A01 CSCL 14B

A new type of neuromagnetometer has been developed to enhance the capability for measuring the magnetic field of the human brain. This system - known as CryoSQUID - results from the marriage of two advanced technologies: a refrigerator incorporating closed-cycle operation of a pair of cryocoolers and a sensor incorporating the superconducting quantum interference device (SQUID). The apparatus is relatively small and requires no supply of liquid helium for initial cooling or operation. Only a source of electrical power is needed. Each sensor relies on a detection coil wound in the geometry of a second-order gradiometer so as to minimize the effects of ambient magnetic noise found in typical unshielded environments. The intrinsic noise level of CryoSQUID is comparable to a magnetic field sensitivity of 20 femtotesla within a one-hertz bandwidth. Residual noise at 1.2 Hz and its harmonics, contributed by the displacer in the Gifford-McMahon cooler, is virtually eliminated in real time by an adaptive filter run on a personal computer. GRA

N88-29276# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
IMPROVEMENTS IN TECHNIQUES OF MICROWAVE THERMOGRAPHY Final Report No. 4, 15 Nov. 1982 - 30 Jun. 1985
Alan H. Barrett Feb. 1988 19 p
(Contract DAMD17-83-C-3025)
(AD-A193620) Avail: NTIS HC A03/MF A01 CSCL 06G

Research efforts were concentrated in the following areas: (1) The development and testing of a reflection compensating radiometer. (2) A theoretical investigation of the variation of microwave penetration depth in human tissue as a function of the aperture size of the contact antenna. (3) Antenna design to give improved penetration depth. (4) A study of the utility of bistatic measurements to detect embedded tumors and aid microwave thermography and hyperthermia. GRA

N88-29277# South Carolina Univ., Columbia.
CONJUNCTIVE MEASUREMENT THEORY: COGNITIVE RESEARCH PROSPECTS Final Report, 15 Aug. 1986 - 30 Nov. 1987
Robert J. Jannarone 25 Jan. 1988 30 p
(Contract N00014-86-K-0817; Proj. RR0-4204)
(AD-A193627; USCMI-88-12) Avail: NTIS HC A03/MF A01 CSCL 05H

A new psychometric development theory based on conjunctive measurement is introduced with an eye toward cognitive modeling. Conjunctive measures are shown that can reflect persons' abilities to: combine component skills that are individually necessary for solving a given task; learn information at one point and successfully use it at a later point; positively transfer learned material from one setting to another; and improve knowledge in different ways between pretests and posttests. Several theoretical issues are also introduced to contrast conjunctive testing with traditional testing. The main distinction is that conjunctive measurement violates test theory's local independence axiom, by allowing individuals to change rather than be unaffected during the measurement process. GRA

N88-29278# New York Univ., New York.
METHODS AND INSTRUMENTATION FOR BIOMAGNETISM Report, 1 Jan. 1987 - 28 Feb. 1988
Lloyd Kaufman, Samuel J. Williamson, and S. E. Robinson 28 Feb. 1988 9 p
(Contracts F49620-85-K-0004; SCEE-HER/86-14)
(AD-A193811; AFOSR-88-0344TR) Avail: NTIS HC A02/MF A01 CSCL 06E

Capabilities for biomagnetic measurements have been advanced by the successful development of a Superconducting Quantum Interference Device (SQUID)-based magnetic sensor that does not rely on liquid helium for cooling. This system, known as CryoSQUID, achieves a sensor noise level that is appropriate for high-sensitivity measurements of the magnetic field of the human brain. It employs an external compressor and a two-stage refrigerator within the sensor's dewar to cool a dc-SQUID and associated detection coil. The sensor can be operated in any orientation, including horizontally and upside-down. GRA

N88-29279# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
ANALYSIS OF THE HOPFIELD NEURAL NETWORKS AND THEIR APPLICATION TO PATTERN RECOGNITION M.S. Thesis
Bernard F. Gerasimas, Jr. 1988 68 p
(AD-A193827) Avail: NTIS HC A04/MF A01 CSCL 06D

This three-part discussion provides the necessary background in understanding the make-up and operation of the generalized biological neuron and its role in memory and pattern recognition

in the brain. There are many specific types of neurons which have adapted to perform specialized operations as part of the central nervous system. Motor neurons deal with the operation of the muscles; optical neurons deal with the operations of the eyes. Although there are differences in physical make-up, their basic operation is similar and is known as the generalized biological neuron. The physical structure and operation of this neuron will be examined. A brief discussion will follow on how the inter-connection and paralleled structure of neural networks in the optical system and cortex of the brain are able to send, store, and recall information dealing with pattern recognition. This will be followed by a brief discussion of the first mathematical model developed of the generalized biological model. Its make-up is the building block for the vast majority of neural network models which followed. GRA

N88-29280# Naval Submarine Medical Research Lab., Groton, Conn.
EFFECT OF HYPOXIA ON SPEECH RECOGNITION IN NOISE Interim Report
Lynne Marshall Jul. 1987 17 p
(AD-A193943; NSMRL-1111) Avail: NTIS HC A03/MF A01 CSCL 06J

Speech-to-babble ratios for 50 percent word recognition were measured in four men, age 30 to 35, while breathing 12 and 21 percent oxygen. There were no differences between the two conditions. Learning effects, however, were seen for the task. As the 12 percent-oxygen level is considerably lower than would be used for routine reduction of fire hazards onboard submarines, reduced oxygen levels at the intermediate levels being considered should not affect speech recognition. GRA

N88-29281# Army Research Inst. of Environmental Medicine, Natick, Mass.
GASTRIC EMPTYING DURING WALKING AND RUNNING: EFFECTS OF VARIED EXERCISE INTENSITY
P. D. Neufer, Andrew J. Young, and Michael N. Sawka Mar. 1988 21 p
(AD-A194025) Avail: NTIS HC A03/MF A01 CSCL 06D

Gastric emptying is increased during running (50 to 70 pct maximal aerobic uptake, VO(sub 2) max) as compared to rest. Whether this increase varies as a function of mode (i.e., walking vs running) and intensity of treadmill exercise is unknown. To examine the gastric emptying characteristics of water during treadmill exercise performed over a wide range of intensities relative to resting conditions, 10 males ingested 400 ml of water prior to each of six 15 min. exercise bouts or 15 min. of seated rest. Three bouts of walking exercise (1.57 m/sec) were performed at increasing grades eliciting approx. 28, 41 or 56 pct of VO(sub 2 max). On a separate day, three bouts of running (2.60 m/sec) exercise were performed at grades eliciting approx. 57, 65 or 75 pct VO(sub 2 max). Gastric emptying was increased during treadmill exercise at all intensities excluding 75 pct VO(sub 2 max) as compared to rest. Gastric emptying was similar for all intensities during walking and at 57 and 65 pct VO(sub 2 max) during running. However, running at 74 pct VO(sub 2 max) decreased the volume of original drink emptied as compared to all lower exercise intensities. Stomach secretions were markedly less during running as compared to walking and rest. These data demonstrate that gastric emptying is similarly increased during both moderate intensity (approx. 28 to 65 pct VO(sub 2 max) walking or running exercise as compared to resting conditions. GRA

N88-29282# Centre d'Essais en Vol, Istres (France). Lab. de Medecine Aerospatiale.
VARIATION OF CAROTID FLOW UNDER LOAD, STUDIED BY THE DOPPLER ECHO METHOD [VARIATION DU DEBIT DE LA CAROTIDE PRIMITIVE SOUS FACTEUR DE CHARGE ETUDIE PAR METHODE ECHO-DOPPLER]
G. Florence, J. M. Clere, H. Marotte, A. Leger, and H. Vieillefond Mar. 1988 72 p In FRENCH
(Rept-1149; ETN-88-92887) Avail: NTIS HC A04/MF A01

The effects of +Gz acceleration (head to feet of the pilot) were investigated in relation to the constraints created by modern combat aircraft. The carotid artery cross section and the blood flow were measured by echotomography and echo Doppler measurements. The cross section does not seem to change under the acceleration load, but the flow diminishes by 5 percent under upward acceleration. ESA

N88-29283# National Aerospace Medical Centre, Soesterberg (Netherlands).
[ACTIVITIES REPORT IN AEROSPACE MEDICINE] Annual Report, 1986 [JAARVERSLAG 1986]
1986 46 p In DUTCH
(ETN-88-92906) Avail: NTIS HC A03/MF A01

Medical examinations, X-ray recordings, electrocardiograms, and electroencephalograms are tabulated. Military examinations, examinations for the Royal Dutch Airlines, and examinations for the A-licence are summarized. The research and development activities are outlined: general medical research, psychodiagnostic investigation and selection, workloads of helicopter pilots, surgery and audiometry, internal medicine, and flight physiology. ESA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-29284# Air Command and Staff Coll., Maxwell AFB, Ala.
FUTURE AIR-TO-AIR TRAINING FOR THE RF-4
John W. Drain Apr. 1988 34 p
(AD-A194363; ACSC-88-0780) Avail: NTIS HC A03/MF A01 CSCL 05F

This study examines the adequacy of current RF-4 upgrade and continuation training programs if the AIM-9L is mounted on the RF-4 and two-ship formation tactics are increasingly employed. Current training at Lead-In Fighter Training (LIFT) and the RF-4 Operational Training Course (OTC) are shown to inadequately train crewmembers in the air-to-air skills they require. This study proposes a new RF-4 OTC air-to-air program based on the air-to-air phase of the F-4 OTC syllabus. Mission Qualification Training (MQT) and Continuation Training (CT) are shown to inadequately maintain the air-to-air skills taught at LIFT and the OTC. Changes to the MQT syllabus and CT program are proposed. The result is a complete training program for the RF-4 crewmember in offensive and defensive Basic Fighter Maneuvers and Defensive Air Combat Maneuvers. GRA

N88-29285# Air Command and Staff Coll., Maxwell AFB, Ala.
PROPOSED IMPROVEMENTS TO THE USAF FLIGHT SCREENING PROGRAM
Douglas W. Knutsen May 1988 49 p
(AD-A194506; ACSC-88-1485) Avail: NTIS HC A03/MF A01 CSCL 05I

This study looks at ways to improve USAF Flight Screening Programs (FSP) in order to reduce attrition in Undergraduate Pilot Training (UPT). A literature search was performed to discover what had already been done in this area. A synopsis of several studies on FSPs is included in the text. This study fills a void in the literature by comparing the USAF FSPs to other service and foreign FSPs. This approach identified several different ways to screen potential pilot candidates. Some of these flight screening techniques could reduce USAF UPT attrition rates if implemented in the USAF FSPs. Further consolidation and standardization of USAF FSPs and increased emphasis on light aircraft screening offer the greatest potential to reduce attrition in UPT. GRA

N88-29286# Air Force Human Resources Lab., Brooks AFB, Tex.
VALIDITY OF THE ACADEMIC APTITUDE COMPOSITE OF THE AIR FORCE OFFICER QUALIFYING TEST (AFOQT) Final Report, Oct. 1986 - Dec. 1987

Darrell D. Hartke and Lawrence O. Short Apr. 1988 14 p
(AD-A194753; AFHRL-TP-87-61) Avail: NTIS HC A03/MF A01 CSCL 05H

This paper addresses the use of the Schmidt-Hunter meta-analysis procedure to determine the generalizability of the Air Force Officer Qualifying Test (AFOQT) validities across Air Force Specialties (AFSs). Meta-analyses were conducted on all available Academic Aptitude composite validities aggregated and disaggregated into major occupational subgroupings. The results suggest that although the validity of the Academic Aptitude composite of the AFOQT may vary across AFSs, the AFOQT is of general value in officer selection. GRA

N88-29287# Human Resources Research Organization, Alexandria, Va.
LITERATURE REVIEW: VALIDITY AND POTENTIAL USEFULNESS OF PSYCHOMOTOR ABILITY TESTS FOR PERSONNEL SELECTION AND CLASSIFICATION
Jeffrey J. McHenry and Sharon R. Rose Apr. 1988 254 p Prepared in cooperation with Personnel Decisions Research Inst., Minneapolis, Minn.
(Contract MDA903-82-C-0531; DA Proj. 2Q2-63731-A-792)
(AD-A193558; ARI-RN-88-13) Avail: NTIS HC A12/MF A01 CSCL 14B

The psychomotor ability literature was reviewed to determine the validity and potential usefulness of psychomotor ability tests for personnel selection and classification. Over 2,200 psychomotor test validity coefficients were located. These were tabulated by ability (using Fleishman's psychomotor ability taxonomy), criterion (e.g., school vs. training vs. job performance), and job type. Analyses of these data showed that psychomotor tests had been used successfully to predict training and job performance for many different occupations. Barriers to the use of psychomotor tests were also investigated. Reliability data indicate that psychomotor measures are not unstable. Moreover, the possibility of using computerized tests in the future to assess psychomotor abilities should eradicate the problem of apparatus differences. GRA

N88-29288# New York Univ., New York.
VISUAL MOTION PERCEPTION AND VISUAL ATTENTIVE PROCESSES Final Report, 30 Sep. 1985 - 30 Nov. 1987
George Sperling Apr. 1988 18 p
(Grant AF-AFOSR-0364-85)
(AD-A193640; AFOSR-88-0551TR) Avail: NTIS HC A03/MF A01 CSCL 06D

The motion projects described in this report include the specification of low level motion detection systems which are both Fourier and NonFourier in kind, investigations in visual persistence in motion, higher level issues in structure from motion, cue integration and decision theory, and object recognition. The attention projects concern the human ability to process information arriving simultaneously at different locations in the visual field and to coordinate concurrent visual and auditory inputs. A common goal of projects was the attention description of the human abilities and limitations in the allocation of mental processing resources, and correspondingly, the theoretical derivation of visual and auditory stimulus codes that take optimum advantage of human abilities. GRA

N88-29289# Navy Personnel Research and Development Center, San Diego, Calif.
RELIABILITY AND CONSTRUCT VALIDITY OF REACTION TIME, INSPECTION TIME AND MACHINE-PACED TESTS OF COGNITIVE SPEED
Gerald E. Larson, Charles R. Merritt, and Kathryn E. Lattin Apr. 1988 14 p
(AD-A193779; NPRDC-TN-88-37) Avail: NTIS HC A03/MF A01 CSCL 05I

In order to evaluate the psychometric characteristics of cognitive speed tests, a battery of reaction time, inspection time, and machine-paced tests was administered to 267 male Navy recruits. Two hundred and twenty of these subjects returned approximately one month later to be retested. The final evaluation of each test was based on whether or not it met two or more of the following standards: Test-retest reliability of .70, split-half reliability of .90, and construct validity of .30. The results indicate that the majority of the tests meet these standards. GRA

N88-29290# Pennsylvania Univ., Philadelphia.
TRANSFORMATIONS OF SHORT-TERM VISUAL MEMORY Final Report, 1 Sep. 1985 - 31 Aug. 1987
Saul Sternberg 15 Mar. 1988 10 p
(Contract N00014-85-K-0643; DA Proj. RR0-4204)
(AD-A193873) Avail: NTIS HC A02/MF A01 CSCL 05H

This is the Final Report of research supported by a contract entitled Transformations of Short-Term Visual Memory. After a section on Short-term dynamics of visual representation: Background and previous research, the report provides a synopsis of the principal research supported by the contract, under the following headings: Technical advances, Principal phenomena in the spatial probe paradigm, Comparison of visual and tactical probes, The roles of uncertainty about position, target, and response in information retrieval, The effect of memory load on the time to name an element indicated by a spatial probe, Nature of the transformation process, Comparison of the time course of slope and intercept changes with probe delay, Test of direct access by color, Comparison of naming of a marked element with location-specific matching, Location-specific matching of digits versus unfamiliar and nameless shapes, Relation of the rapid transformation of small arrays to the decay of iconic memory of large arrays, and Plans for use of event-related potentials (ERPs) to monitor the rapid transformation. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-29291# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
VISUAL EFFECTS IN THE HIGH PERFORMANCE AIRCRAFT COCKPIT
Apr. 1988 149 p Lectures held in Brussels, Belgium, 28-29 Apr. 1988, in Copenhagen, Denmark, 2-3 May 1988, in Ankara, Turkey, 5-6 May 1988, and in Athens, Greece, 9-10 May 1988
(AGARD-LS-156; ISBN-92-835-0456-9) Copyright Avail: NTIS HC A07/MF A01

Vision is the key sensory mode by which a pilot receives the vast majority of the information required to successfully fly the aircraft and accomplish his mission. Visual information is received both directly (viewing through the windscreen, heads-up display and visor) and indirectly (viewing instruments, graphics displays and imaging displays) in a continuous stream. The ability of the pilot to perceive, assimulate and act on this vast amount of visual information greatly depends on the quality of the presentation of this information. There are many factors that can reduce the effective visual capability of the pilot. Many of these factors are presented and their effect on vision and visual performance are discussed. For individual titles, see N88-29292 through N88-29299.

N88-29292# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
VISION AND VISUAL PROTECTION IN FAST JET AIRCRAFT
D. H. Brennan *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 13 p (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

Aircrew flying fast jets such as the F-16 require high visual standards in order to be able to react quickly to tactical and emergency situations within their environment. The basic visual

physiology of importance in flight is discussed together with the visual standards and associated test methods that are necessary for optimum performance. The hazards of solar radiation are reviewed together with suggestions for the optical and spectral quality of visors and corrective eyewear. Author

N88-29293# Royal Danish Air Force, Vojens.
VISUAL RELATED ACCIDENTS/INCIDENTS
L. Simonsen *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 8 p (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

Man has evolved as a creature intended to walk on two feet on the surface of the earth, but has acquired the skill to construct machines which enables him to fly. The process has required this basic man to learn, by training, some necessary skills for adapting his sensory systems. This sensory adaptation is rather fragile and will under situations of stress break down and cause accidents or incidents. Based on accidents/incidents, the different break down modes of man's visual sensory system in the high performance aircraft cockpit are discussed. Author

N88-29294# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.
VISION THROUGH AIRCRAFT TRANSPARENCIES
H. Lee Task *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 14 p (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

The primary purpose is to discuss in detail the optical and visual effects of aircraft transparencies including windscreens, canopies, head-up display (HUD) combiners, and visors. The majority of the paper will treat aircraft windscreens and canopies with primary emphasis on high performance aircraft. Author

N88-29295# Societe pour l'Equipment des Vehicules, Gosselies (Belgium). Service des Essais en Vol.
GENERAL OPERATIONAL AND TRAINING VISUAL CONCERNS
D. Agneessens *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 17 p Prepared in cooperation with Societe Anonyme Belge de Constructions Aeronautiques, Brussels, Belgium (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

After having stated all the requirements for man-machine interface in modern cockpits, taking into account all the operational requirements, and also the physiological and environmental constraints, the emphasis is put on visual displays, more precisely on the heads-up display (HUD). How they are realized, the information which is presented to the pilot and the physiological problems encountered are discussed such as: effects of G and vertigo. For the latter, the most often cited causes of vertigo are studied. New systems are also cited such as Helmet Mounted Display (HMD) or Night Vision Goggles (NVG). Both are still under development. The need for simulators and the physiological problems associated with their use are addressed. Author

N88-29296# Royal Netherlands Air Force, Zeist.
MAINTENANCE OF VISION-RELATED COMPONENTS
J. M. Harts *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 11 p (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

Visual obtained information is of the highest importance for the pilot to fulfill his mission or in some cases to survive. Though the pilot is offered more and more information by audio-means, for example aircraft-warnings, the eyes of the pilot are his most important source of information. Through maintenance of vision-related components it can be assured that needed information can reach the pilot undamaged. Within the Royal Netherlands Airforce this maintenance encloses mainly cleaning, checking, and replacement of the vision-related component. As part of checking and replacement of the Head-Up Display boresighting is essential to assure a proper mounting, needed for accurate weapon-delivery. Author

N88-29297# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.
NIGHT LIGHTING AND NIGHT VISION GOGGLE COMPATIBILITY
Alan R. Pinkus *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 16 p (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

Proper lighting of aircraft instruments, panels, controls, indicators, and displays is essential in high performance aircraft. The lighting must be useable over a large range of ambient conditions; especially during dawn or dusk transitions and at night. It must be uniform, have low glare, and be continuously dimmable to very low luminance levels, so the pilot can become partially dark adapted for good, out-of-the-cockpit vision. Various aspects of cockpit lighting such as intensity levels, contrast, luminance and color uniformity, red versus white versus blue-green general lighting, color coding, and other parameters are discussed. Daytime lighting requirements will be noted throughtout because they are an important part of the overall design of the lighting system. A special area of interest is night vision goggle compatible cockpit lighting. As night missions evolve, night vision goggles (NVGs) are being used with greater frequency. The characteristics and usage of NVGs are overviewed. Methods of achieving night vision goggle compatibility in the cockpit using filtered incandescent lamps, external bezels, floodlighting, light emitting diodes, electroluminescent lamps, microlouver material, and black flight suits are described. Author

N88-29298# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
DISPLAY SYSTEM IMAGE QUALITY
Alan R. Pinkus and H. Lee Task *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 17 p (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

High performance aircraft employ several types of display systems including panel-mounted cathode-ray tube (CRT) displays, head-up displays (HUDs), and helmet-mounted displays (HMDs). These may be used to produce imagery from onboard sensors or to provide information in a symbolic format. There are a number of parameters that are used to characterize these displays such as resolution, contrast ratio, luminance, number of gray shades, line rate, interlace ratio, bandwidth, and modulation transfer functions. In the case of the HUDs and HMDs, there are other parameters that further describe the display such as distortion, transmittance, field of view, exit pupil diameter, vergence, and field curvature. These systems, the measurement of various parameters, and how they affect the quality of the display system are described. In addition, methods will be presented that combine the display parameters with human visual system characteristics to produce image quality metrics that are related to operator performance. Author

N88-29299# Societe pour l'Equipment des Vehicules, Gosselies (Belgium).
FUTURE VISUAL ENVIRONMENT AND CONCERNS
D. Agneessens *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit Apr. 1988 14 p Prepared in cooperation with Societe Anonyme Belge de Constructions Aeronaugiques, Brussels, Belgium (For primary document see N88-29291 23-54)
Copyright Avail: NTIS HC A07/MF A01

Visual displays play an important role in the cockpit, where the information coming from various sensors is presented to the aircrew, after processing by computers. A classification of the displays is done, considering the needs in modern cockpit architecture, where different systems are possible according to the mission envisaged. For daylight operations, HMD/S or FLIR systems are considered, with their advantages but also their

shortcomings and limitations. For night operations, NVG, LLLTV, or FLIR systems are assessed, and the current problems discussed. The protection of the eyes of the aircrew against intense sources of light, such as laser or nuclear flash, is also considered briefly.
Author

N88-29300# High Technology Sensors, Inc., Longwood, Fla.
MINIATURE RESPIRATORY SENSOR Final Report, Aug. 1987 - Jan. 1988
Feb. 1988 33 p
(Contract N00014-87-C-0765)
(AD-A193430) Avail: NTIS HC A03/MF A01 CSCL 05H

A miniature Non-Dispersive Infrared (NDIR) sensor suitable for incorporation within the oxygen mask of an aviator has been demonstrated. The sensor utilizes a miniature infrared source. Current is injected into the source in order to alter its' emissivity to produce modulated infrared output. The source was modulated at 2.3 KHz and it's output focused on a cooled lead selenide detector. Data was taken demonstrating the capability of the sensor to detect expired carbon dioxide profiles in a breath-by-breath manner.
GRA

N88-29301# Army Research Inst. of Environmental Medicine, Natick, Mass.
NUTRIENT REQUIREMENTS FOR HIGH STRESS ENVIRONMENTS Report, for Period Ending Apr. 1988
E. W. Askew 20 Apr. 1988 20 p
(AD-A194595) Avail: NTIS HC A03/MF A01 CSCL 06H

Certain types of stress can cause increased nutrient requirements to maintain physiological or psychological performance levels; however, not all stress elicits this response and relatively few nutrient requirements are actually increased. Environmental stress sometimes causes increased energy (particularly carbohydrate) requirement. Water requirements are often increased by heat, cold, and altitude exposure. Certain aspect of mental performance may be enhanced during environmental stress by dietary precursors of brain neurotransmitters such as tyrosine.
GRA

N88-29302# Olis Engineering, Sedalia, Colo.
ADVANCED DEVELOPMENT WASTE PROCESSING UNIT FOR COMBAT VEHICLES, PHASE 2 Final Report, 1 Sep. 1986 - 31 Jan. 1987
Carter K. Lord 29 Dec. 1987 72 p
(Contract DAAE07-86-C-R089)
(AD-A193793; TACOM-TR-13323) Avail: NTIS HC A04/MF A01 CSCL 24C

The work performed under Phase 2 of this contract has resulted in the design and fabrication of a system capable of the efficient disposal of human waste from within a combat vehicle operating in a nuclear, biologically, or chemically (NBC) environment with minimum impact to the vehicle or to the personnel operating within that vehicle. The Waste Processing Unit (WPU) has been demonstrated both by analysis and testing. The WPU for combat vehicle is currently undergoing further testing at Aberdeen Proving Grounds. Additionally, a modified version of the WPU was fabricated and tested to verify the feasibility of adapting the concept to marine applications. This effort has proven the feasibility of the application, and appears to have significant commercial possibilities.
GRA

N88-29303# Technische Hogeschool, Delft (Netherlands).
IMPLEMENTATION OF A FLEXIBLE LINK MODEL IN A DESIGNED ROBOT SYSTEM, USING THE FINITE ELEMENT METHOD Ph.D. Thesis
Kornelis Hinderik Drent 1988 143 p
(ETN-88-92902) Avail: NTIS HC A07/MF A01

The influence of elastic deformation of robot arm links and supports on positioning accuracy was studied, using a model of the mechanism formed by the links of the arm. This model is based on the finite element method and is integrated in the controller of the robot-arm. The input of the model is taken from the output of a force/torque sensor. Due to the limitation of the computation speed the corrections on the setpoint, needed to compensate for the elastic deformations, are computed only in the end point of the programmed motion. To program the robot an interpreter for commands written in the language IRDATA was developed. The controller was realized on a Motorola 68000 based system, where each axis is controlled by a Motorola 6502 processor based system. Experiments prove that the absolute positioning accuracy of the robot-system, using the model, is 0.1 mm for each load. Previously the difference in absolute position reached with and without a maximum load in the gripper was 6.9 mm.
ESA

N88-29366*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
KNOWLEDGE ELICITATION FOR AN OPERATOR ASSISTANT SYSTEM IN PROCESS CONTROL TASKS
Guy A. Boy *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 131-139 Prepared in cooperation with Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France) (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29367*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MACHINE VISION FOR REAL TIME ORBITAL OPERATIONS
Frank L. Vinz *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 141-155 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29380*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.
ARGES: AN EXPERT SYSTEM FOR FAULT DIAGNOSIS WITHIN SPACE-BASED ECLS SYSTEMS
David W. Pachura, Salem A. Suleiman, and Andrew P. Mendler *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 277-282 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29387*# Georgia Inst. of Tech., Atlanta.
CONCEPTS FOR ROBOT MOTION PRIMITIVES REQUIRED FOR SPACE STATION TELEOPERATIONS
Jeffrey L. Grover and Steven A. E. Suchting (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 337-346 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29408*# Alabama Univ., Huntsville.
PERSONNEL OCCUPIED WOVEN ENVELOPE ROBOT
Francis Wessling, William Teoh, and M. Carl Ziemke *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 513-521 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29409*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.
REMOTE SERVICING OF SPACE SYSTEMS
S. L. Collins and R. B. Purves *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 523-535 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29410*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.
A TELEOPERATED ROBOTIC MANIPULATOR SYSTEM FOR MATERIALS PROCESSING EXPERIMENT SERVICING
Steven Suchting, R. Byron Purves, Jeffrey L. Grover, and Roy Scruggs (Georgia Inst. of Tech., Atlanta.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence

for Space Applications Aug. 1988 p 537-542 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29421*# Tennessee Univ. Space Inst., Tullahoma. Knowledge Engineering Lab.
SEMANTIC BASED MAN-MACHINE INTERFACE FOR REAL-TIME COMMUNICATION Abstract Only
M. Ali and C.-S. Ai *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 613 (For primary document see N88-29351 23-61)
(Grant NAG1-513)
Avail: NTIS HC A99/MF E03 CSCL 05H

N88-29428*# Martin Marietta Aerospace, Denver, Colo. Advanced Automation Technology (Robotics) Group.
NEXT-GENERATION SPACE MANIPULATOR
P. Brunson, W. Chun, and P. Cogeos *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 637-646 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-29304# Sandia National Labs., Albuquerque, N. Mex.
AN OKQPSK MODEM INCORPORATING NUMERICALLY CONTROLLED CARRIER SYNTHESIS
R. E. Oetken Apr. 1988 50 p
(Contract DE-AC04-76DR-00789)
(DE88-009536; SAND-88-8215) Avail: NTIS HC A03

The feasibility of incorporating numerically controlled oscillators (NCO) in communication related applications is evaluated. NCO generation of sinusoids may prove useful in systems requiring precise frequency control, tuning linearity, and orthogonality versus frequency. An OKQPSK modem operating at a data rate of 200 kb/s was fabricated. The modem operates in a back to back hardwired channel and thus does not incorporate carrier or symbol timing recovery. Spectra of the NCO generated sinusoids are presented along with waveforms from the modulation and demodulation process. Generation of sinusoids in the digital domain is a viable alternative to analog oscillators. Implementation of an NCO should be considered when frequency allocation, tuning bandwidth, or frequency hopped transmission requires precise frequency synthesis. DOE

N88-29305 Rochester Univ., N. Y.
DYNAMIC ANALYSIS OF COMPUTER AND COMMUNICATIONS SYSTEMS: SEMI-MARKOV APPROACH Ph.D. Thesis
Yasushi Masuda 1987 288 p
Avail: Univ. Microfilms Order No. DA8803322

Stochastic modeling is playing an important role in performance evaluation of computer and communication systems. The traditional approaches, however, face some limitations. While ergodic information provides useful engineering tools for system management, it cannot yield important dynamic performance measures. Ergodic analysis also ignores the concept of relaxation time. Since the values of the system parameters may change before the system reaches its stationary state, the conclusion reached solely on the basis of ergodic analysis may be incorrect in some instances. In traditional performance evaluation, system reliability, availability, and performance were often evaluated separately. For capturing system dynamics as a whole, it is desirable to develop joint measures combining reliability, availability and performance. Stochastic models were developed and analyzed for the study of dynamic behavior of computer and communication systems. A general framework is given to capture dynamic systems through time dependent performability analysis, providing joint assessment of system reliability, availability, and performance. Dissert. Abstr.

N88-29306# Naval Underwater Systems Center, New London, Conn.
SYSTOLIC ARRAY FAULT TOLERANCE PERFORMANCE ANALYSIS Summary Report
T. C. Choinski and M. H. Leonhardt 5 Apr. 1988 56 p
(AD-A193521; NUSC-TR-8221) Avail: NTIS HC A04/MF A01 CSCL 12E

The reliability performance of six different systolic array fault tolerance techniques are determined and compared in terms of mean time between failure (MTBF). The six techniques include redundant arrays, companion processors, sequential row elimination (SRE), alternate row and column elimination (ARCE), virtual arrays, and tree based architectures. The results demonstrate the importance of the switching function failure rate in achieving theoretical capability. Virtual arrays were found to have the best theoretical potential for improving the reliability of systolic arrays when high throughput is required. All techniques provided comparable performance for low throughput levels. The potential application of graceful degradation techniques to the minimum variance distortionless response (MVDR) adaptive beamforming algorithm is discussed. GRA

N88-29307# Royal Signals and Radar Establishment, Malvern (England).
THE SMITE MODULAR COMPILATION SYSTEM
C. L. Harrold Mar. 1988 18 p
(RSRE-Memo-4145; BR106214; ETN-88-93134) Copyright
Avail: NTIS HC A03/MF A01

The ideas underlying the Modular Compilation System to be used in the SMITE secure computer are outlined. This system prevents users losing track of which generation of source text gave rise to which object code, by binding both together into an abstract data object called a module. Operations give access to the latest versions and require both to be updated together. Linking modules together to form an executable object is performed automatically, so it becomes impossible to forget to relink after updating a module. Configuration control and mixed language working can also be provided. ESA

N88-29308# Royal Signals and Radar Establishment, Malvern (England).
THE SMITE OBJECT ORIENTED BACKING STORE
S. R. Wiseman Mar. 1988 16 p

(RSRE-Memo-4147; BR106213; ETN-88-93135) Copyright Avail: NTIS HC A03/MF A01

The object oriented, write once backing store for the SMITE computer is described. Implementation, which includes garbage collection and compaction, is summarized. The write once nature of the filestore greatly simplifies the garbage collection and compaction algorithms. The existing FLEX implementation, which runs on remicroprogrammed ICL PERQs, is a working demonstration of the effectiveness of the write once structured backing store. However, it performs garbage collection offline, which is inappropriate for the applications proposed for SMITE, though sufficient for a personal workstation. ESA

N88-29309# Royal Signals and Radar Establishment, Malvern (England).
FORMAL SPECIFICATION OF A SECURE DOCUMENT CONTROL SYSTEM FOR SMITE
C. L. Harrold Feb. 1988 75 p
(RSRE-88002; BR106200; ETN-88-93138) Copyright Avail: NTIS HC A04/MF A01

The requirements for a demonstration of a secure electronic registry control system (SERCUS) to be implemented using the security attributes of the SMITE secure capability computer are defined. The specification of SERCUS is divided into two distinct parts. The first part specifies the underlying components of the system, such as the documents, users and displays, and defines the basic operations on them. The second part shows how these components are combined together and constraints added to the basic operations to create a system that is both functional and secure. When users are logged on, SERCUS is both functional and secure. When users are logged on to SERCUS, they are presented with a display that consists of a set of windows. All the window software is completely trustworthy, but may be used to invoke untrusted software. While untrusted software is active in a window the classification of the data is prominently displayed; SERCUS monitors the movement of objects between these windows, and correctly maintains the classification levels. The specification forms the basis of an investigation into techniques for proving conformance between high level specification and code level implementation, required to achieve the highest possible levels of design assurance. ESA

N88-29310* National Aeronautics and Space Administration. Pasadena Office, Calif.
NANOSEQUENCER DIGITAL LOGIC CONTROLLER Patent
Charles R. Lahmeyer, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 23 Aug. 1988 8 p Continuation of US-Patent-Appl-SN-587749, filed 9 Mar. 1984, abandoned
(NASA-Case-NPO-16116-2; US-Patent-4,766,533; US-Patent-Appl-SN-004282; US-Patent-Class-364-200; US-Patent-Appl-SN-587749) Avail: US Patent and Trademark Office CSCL 09B

A digital logic controller provides instruction execution times on the order of 50 nanoseconds and employing read-only memory outputting instructions to a pipeline register, a portion of each instruction providing a status-select control signal and address signals for controlling selection of the next instruction from the read-only memory.
Official Gazette of the U.S. Patent and Trademark Office

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-29311*# Illinois Univ., Urbana. Dept. of Computer Science.
PROCESS MIGRATION IN UNIX ENVIRONMENTS
Chin Lu and J. W. S. Liu [1988] 23 p
(Grant NAG1-613)
(NASA-CR-182951; NAS 1.26:182951) Avail: NTIS HC A03/MF A01 CSCL 09B

To support process migration in UNIX environments, the main problem is how to encapsulate the location dependent features of the system in such a way that a host independent virtual environment is maintained by the migration handlers on the behalf of each migrated process. An object-oriented approach is used to describe the interaction between a process and its environment. More specifically, environmental objects were introduced in UNIX systems to carry out the user-environment interaction. The implementation of the migration handlers is based on both the state consistency criterion and the property consistency criterion.
Author

N88-29312 Tennessee Univ., Knoxville.
OPTIMIZATION-DRIVEN MACHINE-ORIENTED MOTION MEASUREMENT Ph.D. Thesis
Mongi Ali Abidi 1986 365 p
Avail: Univ. Microfilms Order No. DA8802646

Motion measurement is one of the most recent disciplines in the area of computer vision which is one of the segments of the wider area of time-varying imagery and computer applications. In this area, because of many limiting conditions on the data collection and the formulation of the motion measurement problem, the two major trends in this area, namely, the correspondence-based and differentiation-based techniques are regarded as fundamentally different and often generate various solutions stemming from the same set of data. A motion measurement model is proposed which unifies all these techniques, in particular the correspondence and 2- and 1-dimensional differential techniques. This optimization-driven machine-oriented motion measurement model regards all these techniques as an optimization process where the image intensity data of a time-varying image is transformed into a 2-dimensional velocity field through the integration of a forward path representing the measurement extraction process from the pictorial data and a feedback path representing an additional set of topological and scene constraints imposed upon the input and/or output of this system. Dissert. Abstr.

N88-29313# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
THREE DIMENSIONAL GRID GENERATION FOR COMPLEX CONFIGURATIONS: RECENT PROGRESS
Joseph F. Thompson, J. L. Steger, and H. Yoshihara, ed. (Boeing Military Airplane Development, Seattle, Wash.) Mar. 1988 162 p
(AGARD-AG-309; ISBN-92-835-0451-8) Copyright Avail: NTIS HC A08/MF A01

Some of the capabilities of the Computational Fluid Dynamics (CFD) community are surveyed for griding complex three dimensional configurations. The intent is to provide some insight as to the present state of grid generation for aircraft configurations in order to help assess whether this task presents a long term stumbling block to routine use of CFD in aerodynamic applications. A brief review is given of some of the techniques that are available for generating body conforming curvilinear grids. In order to assess capabilities in grid generation, colleagues at selected institutions were solicited to describe their experiences and difficulties in grid generation of complex configurations. For individual titles, see N88-29314 through N88-29325.

N88-29314# Boeing Military Airplane Development, Seattle, Wash.
LESSONS LEARNED IN THE MESH GENERATION FOR PN/S CALCULATIONS
H. Yoshihara *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 15-22 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

Experiences encountered in the 2D mesh generation with the elliptic differential equation method are described for the parabolized Navier-Stokes calculations over a generic fighter at a

supersonic Mach number and for a wing/fuselage at hypersonic Mach numbers. Importance of the mesh quality is stressed, and the need of an improved cost effective treatment of the shocks is pointed out. Author

N88-29315*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THREE-DIMENSIONAL ELLIPTIC GRID GENERATION FOR AN F-16
Reese L. Sorenson *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 23-28 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01 CSCL 09B

A case history depicting the effort to generate a computational grid for the simulation of transonic flow about an F-16 aircraft at realistic flight conditions is presented. The flow solver for which this grid is designed is a zonal one, using the Reynolds averaged Navier-Stokes equations near the surface of the aircraft, and the Euler equations in regions removed from the aircraft. A body conforming global grid, suitable for the Euler equation, is first generated using 3-D Poisson equations having inhomogeneous terms modeled after the 2-D GRAPE code. Regions of the global grid are then designated for zonal refinement as appropriate to accurately model the flow physics. Grid spacing suitable for solution of the Navier-Stokes equations is generated in the refinement zones by simple subdivision of the given coarse grid intervals. That grid generation project is described, with particular emphasis on the global coarse grid. Author

N88-29316# Aircraft Research Association Ltd., Bedford (England).
COMPONENT ADAPTIVE GRID GENERATION FOR AIRCRAFT CONFIGURATIONS
N. P. Weatherill and J. A. Shaw *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 29-39 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

A method is presented which is capable of generating component adaptive grids. The approach is illustrated using wing-body-canard geometries but is applicable to a wide range of complex aerodynamic configurations. The new method of topology generation, combined with the approach taken to grid control, provide a powerful means of exploring the most suitable topology for a given geometry. Grid control parameters are available to the user to modify the grids for particular geometries but the system does not require the user to partake in long interactive sessions on a workstation to generate grids. The suitability of the component adaptive grids for flow simulation is demonstrated by comparing theoretical predictions with experiment. Author

N88-29317# General Dynamics Corp., Fort Worth, Tex.
GENERATION OF MULTIPLE BLOCK GRIDS FOR ARBITRARY 3D GEOMETRIES
J. P. Steinbrenner, S. L. Karman, Jr., and J. R. Chawner *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 40-55 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

A grid generation procedure was developed to create complex block grid systems, beginning with the generation of block surfaces, up to the generation of the full block volume grids. The multiple block concept is shown to facilitate the gridding of very complex geometries and also to allow larger sized grids to be run with a multiple block Euler solver. The entire grid generation process is broken into logical steps, each step is described in detail. Three examples of grid systems generated with these techniques are given, thereby validating the procedure. Finally, current research topics in grid generation and future plans are discussed. Author

N88-29318*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GRID GENERATION ON AND ABOUT A CRANKED-WING FIGHTER AIRCRAFT CONFIGURATION
Robert E. Smith, Joan I. Pitts, Lars-Erik Eriksson, and Michael R. Wiese (Computer Sciences Corp., Hampton, Va.) *In* AGARD, Three Dimensional Grid Generation for Complex Configuration: Recent Progress Mar. 1988 p 56-64 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01 CSCL 09B

Experiences at the NASA Langley Research Center generating grids about a cranked wing fighter aircraft configuration is described. A single block planar grid about the fuselage and canard used with a finite difference Navier-Stokes solver is also described. A dual block nonplanar grid about the complete configuration and used with a finite volume Euler solver is presented. The very important aspect of computing the aircraft surface grid, starting with a standardized model description, is also presented. Author

N88-29319# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany). Helicopter and Military Aircraft Group.
GRID GENERATION FOR AN ADVANCED FIGHTER AIRCRAFT
A. Eberle and W. Schwarz *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 65-76 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

The grid generation process for a realistic and complex fighter type aircraft is described. The method is based on the solution of biharmonic equations and uses a single block concept. Only a few user specified input parameters are necessary for the construction of the space grid and therefore this grid generation system is very simple to handle. The grid is intended for calculations with an Euler code at transonic and supersonic speeds. Author

N88-29320# Tennessee Univ. Space Inst., Tullahoma. Dept. of Engineering Science and Mechanics.
ALGEBRAIC GRID GENERATION FOR FIGHTER TYPE AIRCRAFT
John Steinhoff *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 77-84 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

A systematic procedure is presented for synthesizing a complex computational grid for fighter type aircraft out of a number of simpler elementary grids. This method is useful when a grid is required over an object which, though complex, consists of a number of simpler pieces, such as an aircraft with a number of lifting surfaces. The procedure presented allows a smooth complex grid to be generated which becomes exactly equal to each elementary grid as the surface corresponding to that elementary grid is approached. In this way, methods which may have previously been developed for each piece do not have to be changed and can be used as black boxes, whether they are algebraic, partial differential equation based, or whether the grids are just given numerically. This blending technique is only one of several tools which was used to generate effective grids. Other techniques include projection methods for generating surface grids. Some advantages and limitations of the method are discussed and examples are given of its use in generating complex fighter grids. Author

N88-29321# Mississippi State Univ., Mississippi State. Dept. of Aerospace Engineering.
COMPOSITE GRID GENERATION FOR AIRCRAFT CONFIGURATIONS WITH THE EAGLE CODE
Joe F. Thompson and Lawrence E. Lijewski (Air Force Armament Lab., Eglin AFB, Fla.) *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 85-95 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

A general three dimensional grid generation code based on a composite block structure is discussed. The code can operate either as an algebraic generation system or as an elliptic generation system. Provision is made for orthogonality at boundaries and complete continuity at block interfaces. The code can operate in two or three dimensions, or on a curved surface. The input is

structured to be user oriented, and arbitrary block configurations can be treated. Author

N88-29322# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. for Theoretical Fluid Mechanics.
ANALYTICAL SURFACES AND GRIDS
Helmut Sobieczky *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 96-105 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

The use of analytical shape generation is described for wing-body configurations and flow boundary conditions. Flexibility in geometry definition allows for simple computational grid interpolation. A test case for experiment and code validation is illustrated. Author

N88-29323# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Theoretical Aerodynamics.
MESH GENERATION FOR INDUSTRIAL APPLICATION OF EULER AND NAVIER STOKES SOLVERS
W. Fritz, W. Haase, and W. Seibert *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 106-123 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

A considerable increase has been made in recent years in the ability to compute flow fields about three dimensional configurations. In order to reach their full potential, robust grid generation techniques for complicated aerodynamic configurations must be developed. Three different methods are presented which can be characterized as automatic grid generation for complete aircraft configurations, completely interactive grid generation and generation of solution adaptive grids for Navier-Stokes calculations. Although all the presented grid generation techniques use only elliptical grid generation, they show already that there is no unique grid generation technique. E.R.

N88-29324# Calspan Field Services, Inc., Arnold AFS, Tenn.
EXPERIENCE WITH THREE DIMENSIONAL COMPOSITE GRIDS
J. A. Benek, T. L. Donegan, and N. E. Suhs *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 124-138 Previously announced as N87-26021 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

Experience with the three dimensional, chimera grid embedding scheme is described. Applications of the inviscid version to a multiple body configuration, a wing-body-tail configuration, and an estimate of wind tunnel wall interference are described. Applications to viscous flows include a 3-D cavity and another multi-body configuration. A variety of grid generators is used, and several embedding strategies are described. Author

N88-29325# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.
GRID GENERATION AROUND TRANSPORT AIRCRAFT CONFIGURATIONS USING A MULTI-BLOCK STRUCTURED COMPUTATIONAL DOMAIN
R. Radespiel *In* AGARD, Three Dimensional Grid Generation for Complex Configurations: Recent Progress Mar. 1988 p 139-153 (For primary document see N88-29313 23-61)
Copyright Avail: NTIS HC A08/MF A01

A new grid generation code is described which is based on the multi-block approach. Grid generation around 3-D configurations is divided into 3 major parts, namely, surface definition, surface grid generation and field grid generation. Coons' patches are used to define the surfaces and their intersection lines. Surface grids and field grids are generated using the numerical solution of an elliptic system. An effective means for the control of the grid spacing was developed which is based on an iterative determination of the source terms in the elliptic system. The code is used to generate grids around a wing-body combination and a high bypass nacelle configuration. Author

N88-29326# Information Systems and Technology Center, Wright-Patterson AFB, Ohio. Ada Validation Facility.
Ada (TRADE NAME) COMPILER VALIDATION SUMMARY REPORT: VERDIX CORPORATION VAda-010-03205, VERSION 5.42 MICROVAX 2 HOST AND NATIONAL DB32000 (NS32032 TARGET
21 Jun. 1987 39 p
(AD-A193485; AVF-VSR-110.1087; AVF-87-04-09-VRX) Avail: NTIS HC A03/MF A01 CSCL 12E

This validation summary report describes the extent to which a specific Ada compiler conforms to the Ada Standard, ANSI/MIL-STD-1815A. This report explains all technical terms used within it and thoroughly reports the results of testing this compiler using the Ada Compiler Validation Capability (ACVC). An Ada compiler must be implemented according to the Ada Standard, and any implementation-dependent features must conform to the requirements of the Ada Standard. The Ada Standard must be implemented in its entirety, and nothing can be implemented that is not in the Standard. Even though all validated Ada compilers conform to the Ada Standard, it must be understood that some differences do exist between implementations. The Ada Standard permits some implementation dependencies--for example, the maximum length of identifiers or the maximum values of integer types. Other differences between compilers result from characteristics of particular operating systems, hardware, or implementation strategies. All of the dependencies observed during the process of testing this compiler are given in this report. The information in this report is derived from the test results produced during validation testing. The validation process includes submitting a suite of standardized tests, the ACVC, as inputs to an Ada compiler and evaluating the results. GRA

N88-29327*# Stanford Univ., Calif. Knowledge Systems Lab.
COOPERATING KNOWLEDGE-BASED SYSTEMS Final Report
Edward A. Feigenbaum and Bruce G. Buchanan 10 Aug. 1988 22 p
(Contract NCC2-220)
(NASA-CR-183109; NAS 1.26:183109) Avail: NTIS HC A03/MF A01 CSCL 09B

This final report covers work performed under Contract NCC2-220 between NASA Ames Research Center and the Knowledge Systems Laboratory, Stanford University. The period of research was from March 1, 1987 to February 29, 1988. Topics covered were as follows: (1) concurrent architectures for knowledge-based systems; (2) methods for the solution of geometric constraint satisfaction problems, and (3) reasoning under uncertainty. The research in concurrent architectures was co-funded by DARPA, as part of that agency's Strategic Computing Program. The research has been in progress since 1985, under DARPA and NASA sponsorship. The research in geometric constraint satisfaction has been done in the context of a particular application, that of determining the 3-D structure of complex protein molecules, using the constraints inferred from NMR measurements. Author

N88-29328*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RECURSIVE MASS MATRIX FACTORIZATION AND INVERSION: AN OPERATOR APPROACH TO OPEN- AND CLOSED-CHAIN MULTIBODY DYNAMICS
G. Rodriguez and K. Kreutz 15 Mar. 1988 82 p
(Contract NAS7-918)
(NASA-CR-182516; JPL-Publ-88-11; NAS 1.26:182516) Avail: NTIS HC A05/MF A01 CSCL 09B

This report advances a linear operator approach for analyzing the dynamics of systems of joint-connected rigid bodies.It is established that the mass matrix M for such a system can be factored as M=(I+H phi L)D(I+H phi L) sup T. This yields an immediate inversion M sup -1=(I-H psi L) sup T D sup -1 (I-H psi

L), where H and phi are given by known link geometric parameters, and L, psi and D are obtained recursively by a spatial discrete-step Kalman filter and by the corresponding Riccati equation associated with this filter. The factors (I+H phi L) and (I-H psi L) are lower triangular matrices which are inverses of each other, and D is a diagonal matrix. This factorization and inversion of the mass matrix leads to recursive algorithms for forward dynamics based on spatially recursive filtering and smoothing. The primary motivation for advancing the operator approach is to provide a better means to formulate, analyze and understand spatial recursions in multibody dynamics. This is achieved because the linear operator notation allows manipulation of the equations of motion using a very high-level analytical framework (a spatial operator algebra) that is easy to understand and use. Detailed lower-level recursive algorithms can readily be obtained for inspection from the expressions involving spatial operators. The report consists of two main sections. In Part 1, the problem of serial chain manipulators is analyzed and solved. Extensions to a closed-chain system formed by multiple manipulators moving a common task object are contained in Part 2. To retain ease of exposition in the report, only these two types of multibody systems are considered. However, the same methods can be easily applied to arbitrary multibody systems formed by a collection of joint-connected regid bodies. Author

N88-29329# Minnesota Univ., Minneapolis. Supercomputer Inst.
PIECEWISE-PARABOLIC METHODS FOR SYSTEMS OF HYPERBOLIC CONSERVATION LAWS IN MULTIPROCESSING ENVIRONMENTS Progress Report
P. R. Woodward Apr. 1988 8 p
(Contract DE-FG02-87ER-25035)
(DE88-010202; DOE/ER-25035/1) Avail: NTIS HC A02/MF A01

This paper discusses the use of piecewise-parabolic methods to solve hydrodynamic and magnetohydrodynamic models on multiprocessing computers. DOE

N88-29330# Harry Diamond Labs., Adelphi, Md.
WAVEFORM ANALYSIS ON THE IBM PC Final Report, May - Sep. 1987
Jeffrey J. Falter Apr. 1988 131 p Sponsored by Army Materiel Command, Alexandria, Va.
(AD-A194249; HDL-TM-88-7) Avail: NTIS HC A07/MF A01 CSCL 12E

This report describes an easy-to-use computer program for the IBM PC/XT/AT to perform data analysis on electromagnetic pulse (EMP) waveforms with minimal computer expertise required. A detailed description of the various algorithms is included, as well as introductory users's manual. Some of the data analysis options include linear and cubic spline interpolation, fast Fourier transforms (FFT's), inverse FFT's and numerical integration and differentiation. The program also graphs data waveforms on the screen or on an Epson-compatible printer using linear, logarithmic, or semilog graphs. Additionally, the program reads and writes data files to disk, or data may be manually entered through a digitizing pad. Complete Turbo Pascal program listings are included as appendices. GRA

N88-29331# Wisconsin Univ., Madison. Center for Mathematical Sciences.
A MINITAB MACRO FOR THE KAPLAN-MEIER PRODUCT LIMIT ESTIMATOR AND THE TARONE-WARE CLASS OF TESTS Technical Summary Report
Andrew P. Soms Feb. 1988 12 p
(AD-A194298; CMS-TSR-88-26) Avail: NTIS HC A03/MF A01 CSCL 12E

Minitab is a user-friendly statistical computer package widely used in industry and academia. The Kaplan-Meier product limit estimator (PLE) and the Tarone-Ware class of tests are often used in biostatistics and reliability theory to compare two survival distributions. The Tarone-Ware class of tests is generated by allowing the power of the sample size to run from zero (inclusive) up to and including one. The value 0 corresponds to the Mantel-Haenszel test, .5 to the Tarone-Ware and 1 to the Tarone-Ware version of Gehan's test. This power parameter is specified by the user in the MINITAB constant k4. Miller asserts that the Tarone-Ware class of tests allows the censoring distributions to be different, while Gehan's test does not. However, he also cites evidence that Gehan's tests appears to be insensitive to differences in censoring distributions, so it is not clear which test should be used. A MINITAB macro to calculate Gehan's test has been given by Soms. The main idea of the program is to first break ties between censored and completed observations by adding to the censored observations one-half of the smallest non-zero difference for the ordered combined observations. This does not change the Kaplan-Meier PLE or Tarone-Ware tests. GRA

N88-29332# Air Command and Staff Coll., Maxwell AFB, Ala.
ADP (AUTOMATED DATA PROCESSING) REQUIREMENTS DEFINITION AND DOCUMENTATION THROUGH USER-DEVELOPED PROTOTYPES
Dan W. Hanifen Apr. 1988 51 p
(AD-A194407; ACSC-88-1150) Avail: NTIS HC A04/MF A01 CSCL 12E

The automated data processing requirements definition and documentation process does not work properly today. Users are spending more money for new or modified systems and continue to be dissatisfied with the results. Much of the dissatisfaction can be traced to seven factors that have reduced the effectiveness of the user's ability to define and communicate requirements. But, this process can be improved through user-developed prototypes supplementing the traditional ADP lifecycle. These prototypes include functioning software and hardware, a data list, a brief concept of operations, and written requirements as necessary to supplement the other documentation. User-developed prototypes offer many advantages and can vastly improve user satisfaction. This paper records many of the author's observations over the past 4 years regarding the mechanics of creating, documenting and communicating requirements. It also offers a proven method to improve requirements definition through user-produced prototypes. GRA

N88-29333# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
A PROOF OF THE KAHN PRINCIPLE FOR INPUT/OUTPUT AUTOMATA
Nancy A. Lynch and Eugene W. Stark Jan. 1988 13 p
(Contracts N00014-83-K-0125; N00014-85-K-0168)
(AD-A194454; MIT/LCS/TM-349) Avail: NTIS HC A03/MF A01 CSCL 12F

The authors use input/output automata to define a simple and general model of networks of concurrently executing, nondeterministic processes that communicate through undirectional, named ports. A notion of the input/output relation computed by a process is defined, and determinate processes are defined to be processes whose input/output relations are single-valued. It is shown that determinate processes compute continuous functions, and that networks of determinate processes obey Kahn's fixed-point principle. Although these results are already known, our contribution lies in the fact that the input/output automata model yields extremely simple proofs of them (the simplest we have seen), in spite of its generality. GRA

N88-29334# Naval Research Lab., Washington, D.C.
THE GRADIENT METHOD FOR INTERFACE TRACKING Interim Report, Oct. 1985 - 1988
K. J. Laskey, E. S. Oran, and J. P. Boris 31 May 1988 34 p
(AD-A194477; AD-E500985; NRL-MR-6183) Avail: NTIS HC A03/MF A01 CSCL 17K

An algorithm is presented for advancing a propagating interface in a numerical simulation and it is applied to the problem of a chemical reaction front. The method identifies large gradients characteristic of the interface and then uses the magnitude of the gradient to specify the amount of material conversion occurring at

the interface. In this way the integrated amount of material conversion through the interface can be controlled in a way independent of the detailed local structure of the numerically presented interface. Several test cases demonstrate the ability of the method to propagate an interface with the correct speed and to allow interface merging. The algorithm was developed to allow full use of vector and parallel computer systems. GRA

N88-29335# Institute for Defense Analyses, Alexandria, Va.
LEVEL 1 Ada/SQL (STRUCTURED QUERY LANGUAGE) DATABASE LANGUAGE INTERFACE USER'S GUIDE Final Report
Bill Brykczynski, Fred Friedman, Kerry Hilliard, and Audrey A. Hook Sep. 1987 101 p
(Contract MDA903-84-C-0031)
(AD-A194480; AD-E500985; IDA-M-360; IDA/HQ-87-32693)
Avail: NTIS HC A06/MF A01 CSCL 12E

The purpose of this IDA Memorandum Report is to present a binding specification between the programming language Ada and the database language SQL (Structured Query Language). This document will be used to provide a capability for accessing a relational database from the Ada language and will provide a cross reference between the Ada/SQL language and the SQL language. As a user's guide, M-360 addresses the functionality of the ANSI SQL standard and identifies a subset implementation of it as Level 1. A Level 1 implementation was delivered to the DLA for use with a database package that is intended for regional administrative systems. An Ada application prototype will be implemented to demonstrate software engineering using Ada in the environmental provided for these regional administrative systems. In addition, an IDA Memorandum Report M-361 has been published as a companion document which provides the source listings for the demonstration software that implements this Level 1 version of Ada/SQL. GRA

N88-29336# State Univ. of New York at Buffalo, Amherst.
MULTICRITERIA INTEGER PROGRAMMING FOR PROBLEMS INVOLVING LINEAR AND NONLINEAR UTILITY FUNCTIONS Final Report
Stanley Zionts and Mark H. Karwan 6 May 1988 6 p
(Contract N00014-85-K-0609)
(AD-A194530) Avail: NTIS HC A02/MF A01 CSCL 12D

This document is chiefly a bibliography listing titles such as: An Efficient Interactive Solution Framework for Bicriteria Integer Programming, An Improved Interactive Multicriteria Integer Programming Algorithm, and An Interactive Multicriteria Linear Programming Method Using Constraints and Convex Cones. GRA

N88-29337# Naval Postgraduate School, Monterey, Calif.
FEASIBILITY STUDY OF A MICROPROCESSOR CONTROLLED ACTUATOR TEST MECHANISM M.S. Thesis
Gregory L. Goode Mar. 1988 102 p
(AD-A194654) Avail: NTIS HC A06/MF A01 CSCL 12F

This thesis describes the investigation of the feasibility of using a commercially available microcomputer to control and test a missile fin actuator. Topics discussed include system modelling, automated data acquisition, system identification, simulation and controller design. Modularity, both functional and conceptual, is stressed in the design process as well as integration of modules during the modelling and simulation process. Verification of the computer simulation is used extensively as an interactive tool to modify the system model. The hybrid system under investigation contains analog and discrete components, some of which are both nonlinear and discontinuous. The use of digital systems, their limitations and advantages are highlighted in the modelling of these components and the development of a control system Author (GRA)

N88-29338# Naval Postgraduate School, Monterey, Calif.
A COMPUTER PROGRAM PACKAGE FOR INTRODUCTORY ONE-DIMENSIONAL DIGITAL SIGNAL PROCESSING APPLICATIONS M.S. Thesis
Frank E. Hudik Mar. 1988 294 p
(AD-A194656) Avail: NTIS HC A13/MF A01 CSCL 12E

A need existed for a set of computer programs which could be used by students to solve elementary digital signal processing problems using a personal computer. This project involved the design and implementation of ten algorithms that solve such problems and an additional algorithm that creates plots of the various input and output sequences. The two primary goals of the programs were user friendliness and portability. With these goals in mind, the source code was written using FORTRAN-77 and compiled by a commercially available FORTRAN compiler specifically designed for personal computers. The plotting program uses a FORTRAN-compatible graphics package that is also commercially available. The programs, once compiled, can be distributed to users without the requirement to purchase either a FORTRAN compiler or a graphics package. However, access to a FORTRAN compiler enhances the utility of the programs. Author (GRA)

N88-29339# Space Data Corp., Tempe, Ariz.
MULTI-SENSORY TRACKING MOUNT CONTROL
Bruce Bollerman 8 Mar. 1988 80 p
(Contract DAAD07-87-C-0038)
(AD-A194675; SDC-TM-3628) Avail: NTIS HC A05/MF A01 CSCL 17K

This research develops tracking algorithms for a multi-sensor tracking mount control system. The sensors are mounted to an elevation-over-azimuth pedestal. The tracking error is detected by four independent sensors; namely, RF telemetry system, millimeter wave radar, infrared sensor, and TV video system. The quality of the signal from each sensor is available as a measure of the signal-to-noise ratio. It is assumed that these can be expressed as the variance of the statistical measurement noise distribution. A major requirement of the tracking mount control system is the development of tracking filters to reduce the noise content of the multi-sensor output information. The general formulation of the Kalman filter is presented first. The precise form of the algorithm would depend on the model that is selected for the time evolution of the quantity being measured. Two such cases are considered in detail with the possibility of adapting the filter in the presence of target maneuvers. Two approaches for fusion of the multi-sensor information are presented. Recommended processing hardware and processing time estimates are presented. GRA

N88-29340# California Univ., Berkeley. Center for Pure and Applied Mathematics.
COMPUTER SYSTEMS FOR THE REPRESENTATION AND MANIPULATION OF MATHEMATICAL KNOWLEDGE Final Report, 1 Mar. 1985 - 31 Aug. 1987
Richard J. Fateman 17 Feb. 1988 5 p
(Contract DAAG29-85-K-0070)
(AD-A193547; ARO-21719.15-MA) Avail: NTIS HC A02/MF A01 CSCL 12G

There have been many attempts to design systems which use computers for the manipulation of symbolic mathematical data. Existing systems begin to provide a useful level of assistance to engineers, applied mathematicians, scientific programmers, and others who must perform large-scale or in other ways tedious symbolic, algebraic computation, accurately, as part of their work. However, systems which are currently available suffer from the fact that they are generally weakly-structured collections of ad hoc programs, and do not have systematic methods for the representation of knowledge (data and algorithms). In some cases, there are fundamental conflicts in being required to deal with notations and manipulations from different contexts. The current implementation strategy for systems consists of developing an efficient core algebra system, and tools with which to access it conveniently. These tools include user-programming languages, specialized environments, and graphics interfaces. The goal is to enable a user to deal with the computer and its mathematical knowledge in forms of discourse which are natural for analysis and applications. Parts of the MACSYMA algebra systems are

used as a core system. Although it would have been preferable in some respects to use a smaller modular system, resources were insufficient to build such programs. GRA

N88-29341# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
UNIFICATION AND SET-VALUED FUNCTIONS FOR FUNCTIONAL AND LOGIC PROGRAMMING
Frank S. Silbermann and Bharat Jayaraman Sep. 1987 24 p
(Contract N00014-86-K-0680; Grant NSF DCR-86-3609)
(AD-A193643; TR87-039) Avail: NTIS HC A03/MF A01
CSCL 12E

A new approach to the integration of functional and logic languages is proposed, based on a theory of unification and set valued functions. A set-valued function maps a tuple of input sets into an output set. In this document a language called Setlog illustrates this approach, and gives its model-theoretic, fixed-point, and operational semantics. The model-theoretic semantics and fixed-point semantics resemble that of Horn logic. The operational semantics uses outermost reduction (for set-valued functions) and unification (for terms). The correctness of the operational semantics is established through soundness and completeness proofs. GRA

N88-29342# Colorado Univ., Boulder. Dept. of Computer Science.
SOME LEARNABILITY RESULTS FOR ANALOGICAL GENERATION
Clayton Lewis 16 Jan. 1988 31 p
(Contract N00014-85-K-0452; Proj. RR0-4206)
(AD-A193669; CU-CS-384-88) Avail: NTIS HC A03/MF A01
CSCL 05H

Progress has been made in characterizing formally the capabilities and performance of inductive learning algorithms. Similar characterizations are needed for recently-proposed methods that produce generalizations from small numbers of analyzed examples. The author considers one class of such methods, based on the analogical generalization technique in Anderson and Thompson's PUPS system. It might appear that some to-be-learned structures can be learned by analogy, while others are too chaotic or inconsistent. It is shown that this intuition is correct for a simple form of analogical generalization, so that there are learnable and unlearnable structures for this method. In contrast, the author shows that for PUPS-style generalization analogical structure can be imposed on an arbitrary system (within a broad class he calls command systems). It follows that the constraints on the PUPS-style method lie not in any structural condition on a to-be-learned system but rather in obtaining the knowledge needed to impose analogical structure. GRA

N88-29343# Army Concepts Analysis Agency, Bethesda, Md.
AN ALGORITHM FOR DETERMINING THE LOCATION OF POINTS IN COMPUTER SIMULATIONS Research Paper, Sep. - Oct. 1987
Robert L. Helmhold Oct. 1987 51 p
(AD-A193713; CAA-RP-87-3) Avail: NTIS HC A04/MF A01
CSCL 12E

This paper describes a new and effective algorithm for determining in computer simulations the locations of points relative to prespecified boundary or phase lines. The algorithm is widely applicable, explicitly based on general principles, and user friendly. GRA

N88-29344# Yale Univ., New Haven, Conn. Dept. of Computer Science.
SOLVING THE SYMMETRIC TRIDIAGONAL EIGENVALUE PROBLEM ON THE HYPERCUBE
Ilse C. Ipsen and Elizabeth R. Jessup Jul. 1987 45 p
(Contracts N00014-82-K-0184; N00014-85-K-0461)
(AD-A193905; YALEU/DCS/RR-548) Avail: NTIS HC A03/MF A01 CSCL 12F

This paper describes implementations of Cuppen's method, bisection, and multisection for the computation of all eigenvalues and eigenvectors of a symmetric tridiagonal matrix on a distributed-memory hypercube multiprocessor. Numerical results and timings for Intel's iPSC are presented. Cuppen's method is the most accurate of the three. Near maximal speedups are demonstrated for Cuppen's method when little deflation occurs at intermediate steps, but speedups are significantly reduced when deflation leads to processor load imbalance. Bisection with inverse iteration is seen experimentally to be the fastest method sequentially and in parallel. The independent tasks comprising this approach lead to high parallel efficiency. The relative expected performance of parallel multisection is shown analytically to be problem dependent with arithmetic inefficiency arising in a wide class of problems. Moderate speedups are observed experimentally. GRA

N88-29345# Princeton Univ., N. J. Dept. of Computer Science.
A FAST PARAMETRIC MAXIMUM FLOW ALGORITHM, REVISION
Giorgio Gallo, Michael D. Grigoriadis, and Robert E. Tarjan Jul. 1987 42 p
(Contracts N00014-84-K-0444; N00014-87-K-0467)
(AD-A194026; CS-TR-105-87-Rev) Avail: NTIS HC A03/MF A01 CSCL 12D

The classical maximum flow problem sometimes occurs in settings in which the capacities are not fixed but are functions of a single parameter, and the goal is to find the value of the parameter such that the corresponding maximum flow or minimum cut satisfies some side condition. Finding the desired parameter value requires solving a sequence of related maximum flow problems. It is shown that the recent maximum flow algorithm of Goldberg and Tarjan can be extended to solve an important class of such parametric maximum flow problems, at the cost of only a constant factor in its worst case time bound. Faster algorithms for a variety of combinational optimization problems follow from the result. GRA

N88-29346# Princeton Univ., N. J. Dept. of Computer Science.
A LINEAR-TIME ALGORITHM FOR FINDING A MINIMUM SPANNING PSEUDOFOREST
Harold N. Gabow and Robert E. Tarjan Jul. 1987 9 p
(Contracts N00014-87-K-0467; NSF MCS-83-02648)
(AD-A194029; CS-TR-108-87) Avail: NTIS HC A02/MF A01
CSCL 12D

A pseudoforest is a graph each of whose connected components is a tree or a tree plus an edge; a spanning pseudoforest of a graph contains the greatest number of edges possible. This paper shows that a minimum cost spanning pseudoforest of a graph with n vertices and m edges can be found in O(m + n) time. This implies that a minimum spanning tree can be found in O(m) time for graphs with girth a least log (superscript i) n for some constant i. GRA

N88-29347# Princeton Univ., N. J. Dept. of Computer Science.
FASTER ALGORITHMS FOR THE SHORTEST PATH PROBLEM
Ravindra K. Ahuja, Kurt Mehlhorn, James B. Orlin, and Robert E. Tarjan Mar. 1988 17 p
(Contract N00014-87-K-0467; Grant NSF DCR-86-05962)
(AD-A194031; CS-TR-154-88) Avail: NTIS HC A03/MF A01
CSCL 12D

Efficient implementations of Dijkstra's shortest path algorithm are investigated. A new data structure is proposed, called the redistributive heap, for use in this algorithm. On a network with n vertices, m edges, and nonnegative integer arc costs bounded by C, a one-level form of redistributive heap gives a time bound of Dijkstra's algorithm of O(m + n log C). A two-level form of redistributive heap gives a bound of O(m + n log C/log log C). A combination of a redistributive heap and a previously known data structure called a Fibonacci heap gives a bound of O(m + n square root of (log C)). The best previously known bounds are O(m + n log n) using Fibonacci heaps alone and O(m log log C) using the priority queue structure of Van Emde Boas, Kaas, and Zijlstra. GRA

N88-29348# Princeton Univ., N. J. Dept. of Computer Science.
FASTER SCALING ALGORITHMS FOR NETWORK PROBLEMS
Harold N. Gabow and Robert E. Tarjan Aug. 1987 34 p
(Contract N00014-87-K-0467; Grant NSF MCS-83-02648)
(AD-A194032; CS-TR-111-87) Avail: NTIS HC A03/MF A01
CSCL 12D

Algorithms are prsented for the assignment problem, the transportation problem and the minimum cost flow problem of operations research. The algorithms find a minimum cost solution, but run in time close to the best-known bounds for the corresponding problems without costs. For example, the assignment problem (equivalently, minimum cost matching on a bipartite graph) can be solved in O((sq rt n)nm log (nN)) time, where n, m and N denote the number of vertices, number of edges and largest magnitude of a cost; costs are assumed to be integral. The algorithms work by scaling. In each scaled problem an approximate optimum solution is found, rather than an exact optimum. GRA

N88-29349# Computer Resources International A/S (Denmark).
INVESTIGATION OF THE USE OF HIGH ORDER LANGUAGES (HOLS) FOR ON-BOARD SOFTWARE Final Report
D. Kristiansen Paris, France ESA 15 Jan. 1988 57 p
(Contract ESA-6467/85-NL-PP(SC))
(CRI/FR/HOL-C/1/87; ESA-CR(P)-2559; ETN-88-92918) Avail: NTIS HC A04/MF A01

An infrastructure for development of on-board software (OBSW) in C was established. The OBSW should consist of a subset of on-board data management system functions and of two simple applications. The infrastructure was established on an IBM PC AT. At first a UNIX-like operating system was chosen as development operating system but as the available development tools were unsatisfactory, the DOS operating system was chosen instead. The chosen set of development tools is shown to be satisfactory for developing C on-board software. The OBSW was developed in accordance with ESA software requirements and fulfils the performance requirements. Several problems were encountered, the main one being the interface between modules developed by different companies. It is proposed to use one or more interface control documents accepted by all involved companies. ESA

N88-29350# Royal Signals and Radar Establishment, Malvern (England).
HIDDEN MARKOV MODELS FOR AUTOMATIC SPEECH RECOGNITION: THEORY AND APPLICATION
S. J. Cox 22 Feb. 1988 22 p
(RSRE-Memo-4135; BR106050; ETN-88-93132) Copyright
Avail: NTIS HC A03/MF A01

The mathematical theory of hidden Markov-models and the techniques of applying the theory to automatic speech recognition are reviewed. Results for models with both discrete and continuous partial differential equations in multiple speaker and speaker independent modes are presented. ESA

N88-29351*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SECOND CONFERENCE ON ARTIFICIAL INTELLIGENCE FOR SPACE APPLICATIONS
Thomas Dollman, comp. Aug. 1988 709 p Conference held in Huntsville, Ala., 13-14 Nov. 1986; sponsored by NASA, Marshall Space Flight Center, Huntsville, Ala. and Alabama Univ., Huntsville Sponsored by NASA, Washington, D.C.
(NASA-CP-3007; M-577; NAS 1.55:3007) Avail: NTIS HC A99/MF E03 CSCL 09B

The proceedings of the conference are presented. This second conference on Artificial Intelligence for Space Applications brings together a diversity of scientific and engineering work and is intended to provide an opportunity for those who employ AI methods in space applications to identify common goals and to discuss issues of general interest in the AI community. For individual titles, see N88-29352 through N88-29428.

N88-29352*# National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION AS A VITAL FOCUS FOR ADVANCING THE TECHNOLOGIES OF AUTOMATION AND ROBOTICS c18
Giulio Varsi (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Daniel H. Herman *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 1-6 (For primary document see N88-29351 23-61)
(IAF-86-62) Avail: NTIS HC A99/MF E03 CSCL 22B

A major guideline for the design of the U.S. Space Station is that the Space Station address a wide variety of functions. These functions include the servicing of unmanned assets in space, the support of commercial labs in space and the efficient management of the Space Station itself; the largest space asset. The technologies of Automation and Robotics have the promise to help in reducing Space Station operating costs and to achieve a highly efficient use of the human in space. The use of advanced automation and artificial intelligence techniques, such as expert systems, in Space Station subsystems for activity planning and failure mode management will enable us to reduce dependency on a mission control center and could ultimately result in breaking the umbilical link from Earth to the Space Station. The application of robotic technologies with advanced perception capability and hierarchical intelligent control to servicing system will enable the servicing of assets either in space or in situ with a high degree of human efficiency. The results of studies leading toward the formulation of an automation and robotics plan for Space Station development are presented. Author

N88-29353*# Alabama A & M Univ., Huntsville. Dept. of Computer Science.
A RELATIONAL DATA-KNOWLEDGE BASE SYSTEM AND ITS POTENTIAL IN DEVELOPING A DISTRIBUTED DATA-KNOWLEDGE SYSTEM c82
Eric N. Rahimian and Sara J. Graves (Alabama Univ., Huntsville.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 7-16 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05B

A new approach used in constructing a rational data knowledge base system is described. The relational database is well suited for distribution due to its property of allowing data fragmentation and fragmentation transparency. An example is formulated of a simple relational data knowledge base which may be generalized for use in developing a relational distributed data knowledge base system. The efficiency and ease of application of such a data knowledge base management system is briefly discussed. Also discussed are the potentials of the developed model for sharing the data knowledge base as well as the possible areas of difficulty in implementing the relational data knowledge base management system. Author

N88-29354*# Alabama Univ., Huntsville. Dept. of Computer Science.
HOLOGRAM REPRESENTATION OF DESIGN DATA IN AN EXPERT SYSTEM KNOWLEDGE BASE c82
S. G. Shiva and Peter F. Klon (Boeing Military Airplane Development, Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 17-38 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05B

A novel representational scheme for design object descriptions is presented. An abstract notion of modules and signals is developed as a conceptual foundation for the scheme. This abstraction relates the objects to the meaning of system descriptions. Anchored on this abstraction, a representational model which incorporates dynamic semantics for these objects is presented. This representational model is called a hologram scheme since it represents dual level information, namely, structural and semantic. The benefits of this scheme are presented.
Author

N88-29355*# Alabama Univ., Huntsville.
AN EXPERT SYSTEM FOR RELIABILITY MODELING **c38**
Ernst Goss, Vani Sundararjyer, and Alan Whitten *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 39-46 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 14D

A method is presented for computing the probability of failure of a unit during the next usage or mission based on sound statistical techniques. With the use of logit regression embedded in Lotus 1-2-3 macros, this package computes the probability of unit failure based upon a historical data base. Using this computed probability of failure, the package then makes a replacement recommendation based upon the experts acceptable risk parameters. Author

N88-29356*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A SOFTWARE ENGINEERING APPROACH TO EXPERT SYSTEM DESIGN AND VERIFICATION
Daniel C. Bochsler (LinCom Corp., Houston, Tex.) and Mary Ann Goodwin *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 47-60 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Software engineering design and verification methods for developing expert systems are not yet well defined. Integration of expert system technology into software production environments will require effective software engineering methodologies to support the entire life cycle of expert systems. The software engineering methods used to design and verify an expert system, RENEX, is discussed. RENEX demonstrates autonomous rendezvous and proximity operations, including replanning trajectory events and subsystem fault detection, onboard a space vehicle during flight. The RENEX designers utilized a number of software engineering methodologies to deal with the complex problems inherent in this system. An overview is presented of the methods utilized. Details of the verification process receive special emphasis. The benefits and weaknesses of the methods for supporting the development life cycle of expert systems are evaluated, and recommendations are made based on the overall experiences with the methods. Author

N88-29357*# Alabama A & M Univ., Huntsville. Dept. of Computer and Information Sciences.
ISSUES ON THE USE OF META-KNOWLEDGE IN EXPERT SYSTEMS
Jon Facemire and Imao Chen *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 61-67 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Meta knowledge is knowledge about knowledge; knowledge that is not domain specific but is concerned instead with its own internal structure. Several past systems have used meta-knowledge to improve the nature of the user interface, to maintain the knowledge base, and to control the inference engine. More extensive use of meta-knowledge is probable for the future as larger scale problems are considered. A proposed system architecture is presented and discussed in terms of meta-knowledge applications. The principle components of this system: the user support subsystem, the control structure, the knowledge base, the inference engine, and a learning facility are all outlined and discussed in light of the use of meta-knowledge. Problems with meta-constructs are also mentioned but it is concluded that the use of meta-knowledge is crucial for increasingly autonomous operations. Author

N88-29358*# Alabama Univ., Huntsville. Dept. of Management Information Systems and Management Science.
A KNOWLEDGE-BASED DECISION SUPPORT SYSTEM FOR PAYLOAD SCHEDULING **c63**
Stephen Floyd and Donnie Ford *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 69-78 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The role that artificial intelligence/expert systems technologies play in the development and implementation of effective decision support systems is illustrated. A recently developed prototype system for supporting the scheduling of subsystems and payloads/experiments for NASA's Space Station program is presented and serves to highlight various concepts. The potential integration of knowledge based systems and decision support systems which has been proposed in several recent articles and presentations is illustrated. Author

N88-29359*# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ARTIFICIAL INTELLIGENCE APPLIED TO PROCESS SIGNAL ANALYSIS **c63**
Dan Corsberg *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 79-84 Previously announced as N88-70717 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Many space station processes are highly complex systems subject to sudden, major transients. In any complex process control system, a critical aspect of the human/machine interface is the analysis and display of process information. Human operators can be overwhelmed by large clusters of alarms that inhibit their ability to diagnose and respond to a disturbance. Using artificial intelligence techniques and a knowledge base approach to this problem, the power of the computer can be used to filter and analyze plant sensor data. This will provide operators with a better description of the process state. Once a process state is recognized, automatic action could be initiated and proper system response monitored. Author

N88-29360*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COUPLING EXPERT SYSTEMS AND SIMULATION
K. Kawamura, G. Beale, S. Padalkar, J. Rodriguez-Moscoso, B. J. Hsieh (Vanderbilt Univ., Nashville, Tenn.), F. Vinz, and K. R. Fernandez *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 85-92 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A prototype coupled system called NESS (NASA Expert Simulation System) is described. NESS assists the user in running digital simulations of dynamic systems, interprets the output data to performance specifications, and recommends a suitable series compensator to be added to the simulation model. Author

N88-29361*# Alabama Univ., Huntsville.
OPTIMIZATION OF LOW GRAVITY MATERIALS PROCESSING EXPERIMENTS USING EXPERT SYSTEMS **c29**
Gary L. Workman and Amar Choudry *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 93-103 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22A

The use of an expert system for the control of materials processing experiments in a facility such as the Space Station provides a number of attractive features for insuring that certain critical process parameters can be used to optimize the productivity of the materials processing experiments. The proposed approach to implementation of an expert system utilizes a knowledge base of desired process characteristics which will provide the desired results. The knowledge base for each experiment will be created in conjunction with the scientific investigator in charge of the experiment. Improvements to the knowledge base will be expanded to include self learning sessions in ground based experiments in order to teach the expert system how to respond to perturbations in the process and update the knowledge base on what process change should be implemented in order to reach the desired end product. Design considerations using an on-line real time expert

system such as PICON is studied. The types of experiments evaluated include several types of solidification experiments which will be performed on the Space Station. Author

N88-29362*# Cincinnati Univ., Ohio. Dept. of Electrical and Computer Engineering.
AN APPROACH TO COMBINING HEURISTIC AND QUALITATIVE REASONING IN AN EXPERT SYSTEM **c63**
Wei-Si Jiang, Chia Yung Han, Lian Cheng Tsai, and William G. Wee *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 105-110 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

An approach to combining the heuristic reasoning from shallow knowledge and the qualitative reasoning from deep knowledge is described. The shallow knowledge is represented in production rules and under the direct control of the inference engine. The deep knowledge is represented in frames, which may be put in a relational DataBase Management System. This approach takes advantage of both reasoning schemes and results in improved efficiency as well as expanded problem solving ability. Author

N88-29363*# Alabama Univ., Huntsville. Dept. of History and Philosophy.
EXPERTISE AND REASONING WITH POSSIBILITY: AN EXPLANATION OF MODAL LOGIC AND EXPERT SYSTEMS **c63**
Daniel Rochowiak *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 111-115 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Recently systems of modal reasoning have been brought to the foreground of artificial intelligence studies. The intuitive idea of research efforts in this area is that in addition to the actual world in which sentences have certain truth values there are other worlds in which those sentences have different truth values. Such alternative worlds can be considered as possible worlds, and an agent may or may not have access to some or all of them. This approach to reasoning can be valuable in extending the expert system paradigm. Using the scheme of reasoning proposed by Toulmin, Reike and Janick and the modal system T, a scheme is proposed for expert reasoning that mitigates some of the criticisms raised by Schank and Nickerson. Author

N88-29364*# BDM Corp., Huntsville, Ala.
ANALYST-CENTERED MODELS FOR SYSTEMS DESIGN, ANALYSIS, AND DEVELOPMENT **c63**
A. P. Bukley, Richard H. Pritchard, Steven M. Burke, and P. A. Kiss *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 117-121 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Much has been written about the possible use of Expert Systems (ES) technology for strategic defense system applications, particularly for battle management algorithms and mission planning. It is proposed that ES (or more accurately, Knowledge Based System (KBS)) technology can be used in situations for which no human expert exists, namely to create design and analysis environments that allow an analyst to rapidly pose many different possible problem resolutions in game like fashion and to then work through the solution space in search of the optimal solution. Portions of such an environment exist for expensive AI hardware/software combinations such as the Xerox LOOPS and Intellicorp KEE systems. Efforts are discussed to build an analyst centered model (ACM) using an ES programming environment, ExperOPS5 for a simple missile system tradeoff study. By analyst centered, it is meant that the focus of learning is for the benefit of the analyst, not the model. The model's environment allows the analyst to pose a variety of what if questions without resorting to programming changes. Although not an ES per se, the ACM would allow for a design and analysis environment that is much superior to that of current technologies. Author

N88-29365*# Arizona State Univ., Tempe. Dept. of Computer Science.
AVIONIC EXPERT SYSTEMS **c06**
Forouzan Golshani *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 123-129 Sponsored in part by Sperry Research Trust Foundation (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 01D

At the heart of any intelligent flight control system, there is a knowledge based expert system. The efficiency of these knowledge bases is one of the major factors in the success of aviation and space control systems. In the future, the speed and the capabilities of the expert system and their underlying data base(s) will be the limiting factors in the ability to build more accurate real time space controllers. A methodology is proposed for design and construction of such expert systems. It is noted that existing expert systems are inefficient (slow) in dealing with nontrivial real world situations that involve a vast collection of data. However, current data bases, which are fast in handling large amounts of data, cannot carry out intelligent tasks normally expected from an expert system. The system presented provides the power of deduction (reasoning) along with the efficient mechanisms for management of large data bases. In the system, both straight forward evaluation procedures and sophisticated inference mechanisms coexist. The design methodology is based on mathematics and logic, which ensures the correctness of the final product. Author

N88-29366*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
KNOWLEDGE ELICITATION FOR AN OPERATOR ASSISTANT SYSTEM IN PROCESS CONTROL TASKS **c54**
Guy A. Boy *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 131-139 Prepared in cooperation with Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France) (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

A knowledge based system (KBS) methodology designed to study human machine interactions and levels of autonomy in allocation of process control tasks is presented. Users are provided with operation manuals to assist them in normal and abnormal situations. Unfortunately, operation manuals usually represent only the functioning logic of the system to be controlled. The user logic is often totally different. A method is focused on which illicits user logic to refine a KBS shell called an Operator Assistant (OA). If the OA is to help the user, it is necessary to know what level of autonomy gives the optimal performance of the overall man-machine system. For example, for diagnoses that must be carried out carefully by both the user and the OA, interactions are frequent, and processing is mostly sequential. Other diagnoses can be automated, in which the case the OA must be able to explain its reasoning in an appropriate level of detail. OA structure was used to design a working KBS called HORSES (Human Orbital Refueling System Expert System). Protocol analysis of pilots interacting with this system reveals that the a-priori analytical knowledge becomes more structured with training and the situation patterns more complex and dynamic. This approach can improve the a-priori understanding of human and automatic reasoning. Author

N88-29367*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MACHINE VISION FOR REAL TIME ORBITAL OPERATIONS **c54**
Frank L. Vinz *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 141-155 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

Machine vision for automation and robotic operation of Space Station era systems has the potential for increasing the efficiency of orbital servicing, repair, assembly and docking tasks. A machine vision research project is described in which a TV camera is used

for inputing visual data to a computer so that image processing may be achieved for real time control of these orbital operations. A technique has resulted from this research which reduces computer memory requirements and greatly increases typical computational speed such that it has the potential for development into a real time orbital machine vision system. This technique is called AI BOSS (Analysis of Images by Box Scan and Syntax). Author

N88-29368*# Alabama Univ., Huntsville. Dept. of Computer Science.
AUTOMATIC OBJECT RECOGNITION **c63**
H. S. Ranganath, Pat McIngvale, and Heinz Sage (Army Missile Command, Redstone Arsenal, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 157-166 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Geometric and intensity features are very useful in object recognition. An intensity feature is a measure of contrast between object pixels and background pixels. Geometric features provide shape and size information. A model based approach is presented for computing geometric features. Knowledge about objects and imaging system is used to estimate orientation of objects with respect to the line of sight. Author

N88-29369*# TREC, Inc., Huntsville, Ala.
TWO DIMENSIONAL CONVOLUTE INTEGERS FOR MACHINE VISION AND IMAGE RECOGNITION Abstract Only **c63**
Thomas R. Edwards *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 167 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Machine vision and image recognition require sophisticated image processing prior to the application of Artificial Intelligence. Two Dimensional Convolute Integer Technology is an innovative mathematical approach for addressing machine vision and image recognition. This new technology generates a family of digital operators for addressing optical images and related two dimensional data sets. The operators are regression generated, integer valued, zero phase shifting, convoluting, frequency sensitive, two dimensional low pass, high pass and band pass filters that are mathematically equivalent to surface fitted partial derivatives. These operators are applied non-recursively either as classical convolutions (replacement point values), interstitial point generators (bandwidth broadening or resolution enhancement), or as missing value calculators (compensation for dead array element values). These operators show frequency sensitive feature selection scale invariant properties. Such tasks as boundary/edge enhancement and noise or small size pixel disturbance removal can readily be accomplished. For feature selection tight band pass operators are essential. Results from test cases are given. Author

N88-29370*# Boeing Computer Support Services, Inc., Huntsville, Ala.
FAILURE MODES AND EFFECTS ANALYSIS AUTOMATION **c63**
Cynthia H. Kamhieh, Dannie E. Cutts, and R. Byron Purves (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 169-176 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A failure modes and effects analysis (FMEA) assistant was implemented as a knowledge based system and will be used during design of the Space Station to aid engineers in performing the complex task of tracking failures throughout the entire design effort. The three major directions in which automation was pursued were the clerical components of the FMEA process, the knowledge acquisition aspects of FMEA, and the failure propagation/analysis portions of the FMEA task. The system is accessible to design, safety, and reliability engineers at single user workstations and, although not designed to replace conventional FMEA, it is expected to decrease by many man years the time required to perform the analysis. Author

N88-29371*# Vanderbilt Univ., Nashville, Tenn.
INTELLIGENT TEST INTEGRATION SYSTEM **c63**
J. Sztipanovits, S. Padalkar, J. Rodriguez-Moscoso, K. Kawamura, B. Purves, R. Williams, and H. Biglari (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 177-185 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A new test technology is described which was developed for space system integration. The ultimate purpose of the system is to support the automatic generation of test systems in real time, distributed computing environments. The Intelligent Test Integration System (ITIS) is a knowledge based layer above the traditional test system components which can generate complex test configurations from the specification of test scenarios. Author

N88-29372*# General Research Corp., Huntsville, Ala.
ON RECOGNIZING IGNORANCE **c63**
Richard J. Greene *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 187-191 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

How an expert system reasons about its own ability to deal with a particular problem is studied. Ideally, an expert system ought to rapidly recognize that a particular problem is beyond its abilities and defer to another, perhaps human, expert. This capability is extremely important in domains where expert systems may control life critical processes such as air traffic control, medicine, strategic defense, and manned space exploration. The methods used by knowledge engineers to infuse an expert system with knowledge of its own limitations is surveyed. A computability theory is employed to analyze the general problem of meta-knowledge and to give insight into the efficacy of specific solutions. Author

N88-29373*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DAISY-DAMP: A DISTRIBUTED AI SYSTEM FOR THE DYNAMIC ALLOCATION AND MANAGEMENT OF POWER **c63**
Steven B. Hall and Peter C. Ohler *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 201-208 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

One of the critical parameters that must be addressed when designing a loosely coupled Distributed AI SYstem (DAISY) has to do with the degree to which authority is centralized or decentralized. The decision to implement the Dynamic Allocation and Management of Power (DAMP) system as a network of cooperating agents mandated this study. The DAISY-DAMP problem is described; the component agents of the system are characterized; and the communication protocols system elucidated. The motivations and advantages in designing the system with authority decentralized is discussed. Progress in the area of Speech Act theory is proposed as playing a role in constructing decentralized systems. Author

N88-29374*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
KNOWLEDGE-BASED FAULT DIAGNOSIS ON FUTURE SPACE VEHICLES **c18**
Robert L. Schroeder *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 209-213 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

There is a need for knowledge based fault detection and diagnostics on the future generation of space vehicles. These vehicles have a more demanding set of requirements than today's vehicles. A tank pressurization system was chosen to explore the potential for an on-board knowledge based fault detection and diagnostic system. Specific tasks were to investigate sensor based diagnostics, appropriate levels of knowledge representation, the generation of further diagnostic tests, the diagnosis of two failures, and effective forms of graphical representation. Author

N88-29375*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERT SYSTEMS FOR MSFC POWER SYSTEMS c20
David J. Weeks *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 215-226 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 10B

Future space vehicles and platforms including Space Station will possess complex power systems. These systems will require a high level of autonomous operation to allow the crew to concentrate on mission activities and to limit the number of ground support personnel to a reasonable number. The Electrical Power Branch at NASA-Marshall is developing advanced automation approaches which will enable the necessary levels of autonomy. These approaches include the utilization of knowledge based or expert systems. Author

N88-29376*# Vanderbilt Univ., Nashville, Tenn.
A GENERIC EXPERT SYSTEM FOR MATERIALS PROCESSING IN SPACE c29
Kristinn Andersen, George E. Cook, and Alvin M. Strauss *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 227-236 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22A

A generic expert system is described for inspecting materials processed in space (MPS). The system may be applied, with the appropriate knowledge base, to any of the nondestructive testing methods (NDT) which are appropriate to MPS. Regardless of the method being used, the inspection process consists of three tasks: (1) signal or image processing of the NDT output and feature extraction, (2) interpretation of features in terms of MPS discontinuities, and (3) evaiuation of the quality of the MPS based upon industry standards. In contrast to rule based systems, this system represents its knowledge as multidimensional vectors and appropriate functions on them. Currently, the expert system accepts manual input of observed features. Once the expert system has been tested and compared to human expert inspectors, a vision front-end will be developed to complete automation of the expert MPS inspection system, based on visual discontuities. Then the data base will be extended to include a variety of other NDT methods. In addition to functional performance, ease of use was established through menu window driven input as well as flexibility in building, using and modifying data bases for different applications. Author

N88-29377*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.
A PLAN FOR TIME-PHASED INCORPORATION OF AUTOMATION AND ROBOTICS ON THE US SPACE STATION c18
R. B. Purves, P. S. Lin, and E. M. Fisher, Jr. *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 237-245 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

A plan for the incorporation of Automation and Robotics technology on the Space Station is presented. The time phased introduction of twenty two selected candidates is set forth in accordance with a technology development forecast. Twenty candidates were chosed primarily for their potential to relieve the crew of mundane or dangerous operations and maintenance burdens, thus freeing crew time for mission duties and enhancing safety. Two candidates were chosen based on a potential for increasing the productivity of laboratory experiments and thus directly enhancing the scientific value of the Space Station. A technology assessment for each candidate investigates present state of the art, development timelines including space qualification considerations, and potential for technology transfer to earth applications. Each candidate is evaluated using a crew workload model driven by crew size, number of pressurized U.S. modules and external payloads, which makes it possible to assess the impact of automation during a growth scenario. Costs for each increment of implementation are estimated and accumulated. Author

N88-29378*# Boeing Computer Services Co., Seattle, Wash. Advanced Technology Center for Computer Sciences.
MOTION PLANNING FOR A FREE-FLYING ROBOT c18
Donald Leo Kaiser and Patrick J. Hawkins *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 247-255 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

An investigation is presented of motion planning combining low level control and obstacle avoidance for a free flying robot. This free flying robot is an outgrowth of the concept of an assistant for astronauts on the U.S. Space Station and Shuttle. A motion planner based on the Khatib potential field approach is described. Because of the uncluttered environment in space, it generates a path from representation of known obstacles rather than from a representation of free space. A global planner supplies the low level controller with interim points between the current position and the desired goal position so that the vehicle does not become trapped by local minima, a phenomenon of the potential field approach. Discussion of the feasibility of this system for space applications is presented. Author

N88-29379*# Alabama Univ., Huntsville.
OMV DOCKING SIMULATOR c14
W. Teoh and J. Hawkins (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 257-276 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 14B

The Boeing Orbital Maneuvering Vehicle (OMV) Docking and Proximity Operation System (DAPOS) was completed. The system constructed involves the use of four separate processors. Appropriate software was developed that drives each of these four processors. The hand controller logic coordinates all the activities in the control station, and communicates with the OMV mathematical model. The state vector generated by the model is in turn transmitted to the control station as well as the POLY 2000 (via the ALCYON host computer) for real time graphics generation. The OMV characteristics are stored in a data file which may be easily updated and modified without disturbing the software, thereby making the system very flexible. The current system supports two types of hand controllers. The system was flown by several volunteers, some of whom are airplane pilots. A user manual is also enclosed. Author

N88-29380*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.
ARGES: AN EXPERT SYSTEM FOR FAULT DIAGNOSIS WITHIN SPACE-BASED ECLS SYSTEMS c54
David W. Pachura, Salem A. Suleiman, and Andrew P. Mendler *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 277-282 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

ARGES (Atmospheric Revitalization Group Expert System) is a demonstration prototype expert system for fault management for the Solid Amine, Water Desorbed (SAWD) CO2 removal assembly, associated with the Environmental Control and Life Support (ECLS) System. ARGES monitors and reduces data in real time from either the SAWD controller or a simulation of the SAWD assembly.

It can detect gradual degradations or predict failures. This allows graceful shutdown and scheduled maintenance, which reduces crew maintenance overhead. Status and fault information is presented in a user interface that simulates what would be seen by a crewperson. The user interface employs animated color graphics and an object oriented approach to provide detailed status information, fault identification, and explanation of reasoning in a rapidly assimulated manner. In addition, ARGES recommends possible courses of action for predicted and actual faults. ARGES is seen as a forerunner of AI-based fault management systems for manned space systems. Author

N88-29381*# TRW, Inc., Redondo Beach, Calif.
SCARES: A SPACECRAFT CONTROL ANOMALY RESOLUTION EXPERT SYSTEM **c18**
Marc Hamilton *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 283-291 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

The current pace of technological development is reflected in the increased mission lifetime of each new generation of satellite. Coupled with this has come a reduced availability of experts to provide technical assistance in satellite operation on a day to day basis. Given such an environment, an expert system is discussed based on architecture for spacecraft anomaly resolution. By capturing deep knowledge about a spacecraft, the system is able to detect and diagnose fault better than previous conventional approaches. A prototype expert system named SCARES (applied only to spacecraft attitude control system) is discussed. Extension of the prototype to handle anomalies in other systems of the satellite is also discussed. Author

N88-29382*# General Dynamics Corp., San Diego, Calif. Data Systems Div.
ARCHETYPING: A SOFTWARE GENERATION AND MANAGEMENT METHODOLOGY
Hugh B. Rothman and Stanley M. Przybylinski *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 293-302 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Many knowledge based software generation methods have been proposed to improve software quality and programmer productivity. Several government and industry initiatives have focused on software reusability as one solution to these problems. DARTS (trademark), a General Dynamics proprietary symbolic processing technology, provides a unique solution to the reuse problem: archtyping. Archtyping is the embedding of high order language statements in text files. An advanced macroprocessor uses the text files to generate new versions of complex software systems. A DARTS program, the Software Generation and Configuration Management (SGCM) System automates the archtyping process and maintenance cycle. The DARTS technology is briefly discussed, archtyping is described, and the SGCM system is presented in detail. Author

N88-29383*# Martin Marietta Aerospace, Denver, Colo.
A SCHEDULING AND RESOURCE MANAGEMENT SYSTEM FOR SPACE APPLICATIONS **c81**
Daniel L. Britt, Amy L. Geoffroy, and John R. Gohring *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 303-310 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05A

Every spacecraft, whether in orbit around the earth or an a deep space flight, has at its disposal limited amounts of the resources for it to accomplish its mission. Activity scheduling is currently a costly, human intensive task which requires a great deal of expertise. It belongs to a class of problems whose complexity increases exponentially with the number of operations. NASA has in the past accomplished this task by using a great deal of manpower, a large number of negotiating sessions, interminable bouts of phone tag, and mountains of paperwork. Lately the situation has improved with the introduction of automated scheduling techniques, but these to date still require expert involvement and fall short in some important ways. A prototype activity scheduler, MAESTRO, is introduced which is capable of meeting the needs of many NASA missions, eventually to include the Space Station. The approach to resource constrained scheduling is first discussed, then the intended domain for MAESTRO is described along with its design and current capabilities. A description of planned enhancements and revisions to the systems is also presented. Author

N88-29384*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
AN EXPERT SYSTEMS APPLICATION TO SPACE BASE DATA PROCESSING **c81**
Stephen M. Babb *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 311-318 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05A

The advent of space vehicles with their increased data requirements are reflected in the complexity of future telemetry systems. Space based operations with its immense operating costs will shift the burden of data processing and routine analysis from the space station to the Orbital Transfer Vehicle (OTV). A research and development project is described which addresses the real time onboard data processing tasks associated with a space based vehicle, specifically focusing on an implementation of an expert system. Author

N88-29385*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.
INTELLIGENT RESOURCE MANAGEMENT FOR LOCAL AREA NETWORKS: APPROACH AND EVOLUTION
Roger Meike *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 319-324 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The Data Management System network is a complex and important part of manned space platforms. Its efficient operation is vital to crew, subsystems and experiments. AI is being considered to aid in the initial design of the network and to augment the management of its operation. The Intelligent Resource Management for Local Area Networks (IRMA-LAN) project is concerned with the application of AI techniques to network configuration and management. A network simulation was constructed employing real time process scheduling for realistic loads, and utilizing the IEEE 802.4 token passing scheme. This simulation is an integral part of the construction of the IRMA-LAN system. From it, a causal model is being constructed for use in prediction and deep reasoning about the system configuration. An AI network design advisor is being added to help in the design of an efficient network. The AI portion of the system is planned to evolve into a dynamic network management aid. The approach, the integrated simulation, project evolution, and some initial results are described. Author

N88-29386*# Boeing Co., Seattle, Wash. Intelligent Robotics and Perception.
DISTRIBUTED COOPERATING PROCESSES IN A MOBILE ROBOT CONTROL SYSTEM **c63**
Thomas L. Skillman, Jr. *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 325-336 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A mobile inspection robot has been proposed for the NASA Space Station. It will be a free flying autonomous vehicle that will leave a berthing unit to accomplish a variety of inspection tasks around the Space Station, and then return to its berth to recharge, refuel, and transfer information. The Flying Eye robot will receive

voice communication to change its attitude, move at a constant velocity, and move to a predefined location along a self generated path. This mobile robot control system requires integration of traditional command and control techniques with a number of AI technologies. Speech recognition, natural language understanding, task and path planning, sensory abstraction and pattern recognition are all required for successful implementation. The interface between the traditional numeric control techniques and the symbolic processing to the AI technologies must be developed, and a distributed computing approach will be needed to meet the real time computing requirements. To study the integration of the elements of this project, a novel mobile robot control architecture and simulation based on the blackboard architecture was developed. The control system operation and structure is discussed. Author

N88-29387*# Georgia Inst. of Tech., Atlanta.
CONCEPTS FOR ROBOT MOTION PRIMITIVES REQUIRED FOR SPACE STATION TELEOPERATIONS **c54**
Jeffrey L. Grover and Steven A. E. Suchting (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 337-346 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

Ground controlled teleoperations are expected to be used to augment Space Station manned extravehicular activities (EVA) and Intravehicular activities (IVA). However, ground controlled teleoperations will encounter communications time delays of from 3 to 8 secs. Time delays greater than 1 sec have been shown to be detrimental to safe and efficient teleoperations. Therefore, concepts must be developed to overcome the hazards and limitations of time delays when performing teleoperations using robots. The concept for robot motion primitives incorporate force/torque and tactile sensor feedback to implement the degree of autonomy required for interactive, ground controlled telerobotics. Several primitives are studied that augment human initiated actions by providing rapid response interaction with the physical environment of a telerobot. These primitives are detailed. They constitute a level of intelligent sensing and reaction required to augment human actions through autonomous interaction with the physical environment. Author

N88-29388*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE USE OF COMPUTER GRAPHIC SIMULATION IN THE DEVELOPMENT OF ROBOTIC SYSTEMS
Ken Fernandez *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 347-354 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The use of computer graphic simulation techniques to resolve critical design and operational issues for robotic systems is described. Use of this technology will result in greatly improved systems and reduced development costs. The major design issues in developing effective robotic systems are discussed and the use of ROBOSIM, a NASA developed simulation tool, to address these issues is presented. Three representative simulation case studies are reviewed: off-line programming of the robotic welding development cell for the Space Shuttle Main Engine; the integration of a sensor to control the robot used for removing the Thermal Protection System from the Solid Rocket Booster; and the development of a teleoperator/robot mechanism for the Orbital Maneuvering Vehicle. Author

N88-29389*# Boeing Computer Support Services, Inc., Huntsville, Ala.
GENERIC SUPERVISOR: A KNOWLEDGE-BASED TOOL FOR CONTROL OF SPACE STATION ON-BOARD SYSTEMS **c63**
J. R. Carnes and R. Nelson (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 355-362 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The concept of a generic module for management of onboard systems grew out of the structured analysis effort for the Space Station software. Hierarchical specification of subsystems software revealed that nontrivial supervisory elements are required at all levels. The number of supervisors (and subsequent software) required to implement the hierarchical control over onboard functions comprise a large portion of the Space Station software. Thus, a generic knowledge based supervisory module significantly reduces the amount of software developed. This module, the Generic Supervisor, depends on its knowledge of control to provide direction for subordinates and feedback to superiors within a specific subsystem area. The Generic Supervisor provides an adaptable and maintainable control system. A portion of the Space Station Environmental Control and Life Support System (ECLSS) was implemented as a hierarchy of supervisors. This prototype implementation demonstrates the feasibility of a generic knowledge based supervisor, and its facility to meet complex mission requirements. Author

N88-29390*# Vanderbilt Univ., Nashville, Tenn.
PROGRAMMING MODEL FOR DISTRIBUTED INTELLIGENT SYSTEMS **c63**
J. Sztipanovits, C. Biegl, G. Karsai, N. Bogunovic, B. Purves, R. Williams, and T. Christiansen (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 363-371 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A programming model and architecture which was developed for the design and implementation of complex, heterogeneous measurement and control systems is described. The Multigraph Architecture integrates artificial intelligence techniques with conventional software technologies, offers a unified framework for distributed and shared memory based parallel computational models and supports multiple programming paradigms. The system can be implemented on different hardware architectures and can be adapted to strongly different applications. Author

N88-29391*# RECOM Software, Inc., San Jose, Calif.
AI AND SIMULATION: WHAT CAN THEY LEARN FROM EACH OTHER
Silvano P. Colombano *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 373-381 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Simulation and Artificial Intelligence share a fertile common ground both from a practical and from a conceptual point of view. Strengths and weaknesses of both Knowledge Based System and Modeling and Simulation are examined and three types of systems that combine the strengths of both technologies are discussed. These types of systems are a practical starting point, however, the real strengths of both technologies will be exploited only when they are combined in a common knowledge representation paradigm. From an even deeper conceptual point of view, one might even argue that the ability to reason from a set of facts (i.e., Expert System) is less representative of human reasoning than the ability to make a model of the world, change it as required, and derive conclusions about the expected behavior of world entities. This is a fundamental problem in AI, and Modeling Theory can contribute to its solution. The application of Knowledge Engineering technology to a Distributed Processing Network Simulator (DPNS) is discussed. Author

N88-29392*# Teledyne Brown Engineering, Huntsville, Ala.
SOFTWARE DEVELOPMENT WITHOUT LANGUAGES
Haywood S. Osborne *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 383-388 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Automatic programming generally involves the construction of a formal specification; i.e., one which allows unambiguous interpretation by tools for the subsequent production of the corresponding software. Previous practical efforts in this direction have focused on the serious problems of: (1) designing the optimum specification language; and (2) mapping (translating or compiling) from this specification language to the program itself. The approach proposed bypasses the above problems. It postulates that the specification proper should be an intermediate form, with the sole function of containing information sufficient to facilitate construction of programs and also of matching documentation. Thus, the means of forming the intermediary becomes a human factors task rather than a linguistic one; human users will read documents generated from the specification, rather than the specification itself. Author

N88-29393*# Alabama Univ., Huntsville. Dept. of Computer Science.

KNOWLEDGE BASED PROGRAMMING ENVIRONMENTS: A PERSPECTIVE

Ashok T. Amin *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 389-394 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

Programming environments is an area of recent origin and refers to an integrated set of tools, such as program library, text editor, compiler, and debugger, in support of program development. Understanding of programs and programming has lead to automated techniques for program development. Knowledge based programming system using program transformations offer significant impact on future program development methodologies. A review of recent developments in the area of knowledge based programming environments, from the perspective of software engineering, is presented. Author

N88-29394*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.

KNOWLEDGE ACQUISITION AND RAPID PROTYPING OF AN EXPERT SYSTEM: DEALING WITH REAL WORLD PROBLEMS **c63**

Patrick A. Bailey and Brett B. Doehr *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 395-402 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

The knowledge engineering and rapid prototyping phases of an expert system that does fault handling for a Solid Amine, Water Desorbed CO2 removal assembly for the Environmental Control and Life Support System for space based platforms are addressed. The knowledge acquisition phase for this project was interesting because it could not follow the textbook examples. As a result of this, a variety of methods were used during the knowledge acquisition task. The use of rapid prototyping and the need for a flexible prototype suggested certain types of knowledge representation. By combining various techniques, a representative subset of faults and a method for handling those faults was achieved. The experiences should prove useful for developing future fault handling expert systems under similar constraints. Author

N88-29395*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.

REASONING ABOUT FAULT DIAGNOSIS FOR THE SPACE STATION COMMON MODULE THERMAL CONTROL SYSTEM **c18**

G. Vachtsevanos, H. Hexmoor, and B. Purves (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 403-412 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 22B

The proposed common module thermal control system for the Space Station is designed to integrate thermal distribution and thermal control functions in order to transport heat and provide environmental temperature control through the common module. When the thermal system is operating in an off-normal state, due to component faults, an intelligent controller is called upon to diagnose the fault type, identify the fault location and determine the appropriate control action required to isolate the faulty component. A methodology is introduced for fault diagnosis based upon a combination of signal redundancy techniques and fuzzy logic. An expert system utilizes parity space representation and analytic redundancy to derive fault symptoms, the aggregate of which is assessed by a multivalued rule based system. A subscale laboratory model of the thermal control system designed is used as the testbed for the study. Author

N88-29396*# Space Telescope Science Inst., Baltimore, Md.

AUTOMATED GENERATION OF SPACECRAFT ACTIVITY PLANS **c63**

Donald A. Rosenthal *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 413-417 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

An expert system is described which is currently in place in the ground support system of the Hubble Space Telescope (HST). Known as the Transformation system, it is used to process proposals submitted by the HST's world wide user community, converting the scientific descriptions of the astronomical observations into detailed spacecraft activities which are linked in time. These detailed activities are formatted to be both readable by the telescope operations staff and directly schedulable by the planning and scheduling portion of the ground system. The implementation of the Transformation system is particularly interesting as the system was developed at the same time that its target system (the planning and scheduling system) was being built. Author

N88-29397*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

INTELLIGENT INTERFACES FOR EXPERT SYSTEMS **c63**

James A. Villarreal and Lui Wang *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 419-426 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

Vital to the success of an expert system is an interface to the user which performs intelligently. A generic intelligent interface is being developed for expert systems. This intelligent interface was developed around the in-house developed Expert System for the Flight Analysis System (ESFAS). The Flight Analysis System (FAS) is comprised of 84 configuration controlled FORTRAN subroutines that are used in the preflight analysis of the space shuttle. In order to use FAS proficiently, a person must be knowledgeable in the areas of flight mechanics, the procedures involved in deploying a certain payload, and an overall understanding of the FAS. ESFAS, still in its developmental stage, is taking into account much of this knowledge. The generic intelligent interface involves the integration of a speech recognizer and synthesizer, a preparser, and a natural language parser to ESFAS. The speech recognizer being used is capable of recognizing 1000 words of connected speech. The natural language parser is a commercial software package which uses caseframe instantiation in processing the streams of words from the speech recognizer or the keyboard. The systems configuration is described along with capabilities and drawbacks. Author

N88-29398*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

REQUIREMENTS FOR A TOOL TO AID IN THE DEVELOPMENT OF EXPERT SYSTEMS FOR SPACE STATION APPLICATIONS

Chris Culbert *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug.

1988 p 427-433 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The Space Station Program is currently in the early stages of design. The extended life of the program and the wide range of planned capabilities present NASA with a major challenge to make effective use of all available resources. Expert systems may represent one of the most important techniques NASA can use to improve performance and functionality of the Space Station. The recent growth in expert system applications has been spurred by the availability of commercial expert system development tools. These state-of-the-art tools provide multiple representation techniques, sophisticated user interfaces, and powerful development tools; allowing programmers to develop expert systems without requiring years of training in knowledge engineering. The requirements are described for a software tool to aid in the development and delivery of expert systems intended for use in the Space Station Program. The intent is to define a tool that would be useful for a very broad range of expert system applications. Author

N88-29399*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
BENCHMARKING EXPERT SYSTEM TOOLS c63
Gary Riley *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 435-441 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

As part of its evaluation of new technologies, the Artificial Intelligence Section of the Mission Planning and Analysis Div. at NASA-Johnson has made timing tests of several expert system building tools. Among the production systems tested were Automated Reasoning Tool, several versions of OPS5, and CLIPS (C Language Integrated Production System), an expert system builder developed by the AI section. Also included in the test were a Zetalisp version of the benchmark along with four versions of the benchmark written in Knowledge Engineering Environment, an object oriented, frame based expert system tool. The benchmarks used for testing are studied. Author

N88-29400*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TWO IMPLEMENTATIONS OF THE EXPERT SYSTEM FOR THE FLIGHT ANALYSIS SYSTEM (ESFAS) PROJECT c63
Lui Wang *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 443-447 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A comparison is made between the two most sophisticated expert system building tools, the Automated Reasoning Tool (ART) and the Knowledge Engineering Environment (KEE). The same problem domain (ESFAS) was used in making the comparison. The Expert System for the Flight Analysis System (ESFAS) acts as an intelligent front end for the Flight Analysis System (FAS). FAS is a complex configuration controlled set of interrelated processors (FORTRAN routines) which will be used by the Mission Planning and Analysis Div. (MPAD) to design and analyze Shuttle and potential Space Station missions. Implementations of ESFAS are described. The two versions represent very different programming paradigms; ART uses rules and KEE uses objects. Due to each of the tools philosophical differences, KEE is implemented using a depth first traversal algorithm, whereas ART uses a user directed traversal method. Either tool could be used to solve this particular problem. Author

N88-29401*# Alabama Univ., Huntsville.
LIFE-SPAN KNOWLEDGE ENGINEERING FOR SPACE OPERATIONS c63
Dan Hays *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 449-456 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Ordinarily, knowledge engineering is thought of as the process of translating the knowledge and problem solving strategies of a human expert into rules and procedures incorporated into a machine based expert system which can, given adequate input, solve the same sorts of problems as the expert. One appeal of these knowledge based systems is their ability to take care of problems without having a human expert present. For work in space, being independent of humans is especially important both for situations where devices will be in remote or dangerous locales and for situations such as space stations where human resources are limited and schedules are tight. In qualification of the above ideas, it is argued herein that the notion of knowledge engineering and the expectations for its application should be extended beyond the period of construction of unit expert systems to the entire knowledge system management associated with one or another real systems, whether it is a piece of hardware or an entire human-machine operation such as a lunar factory. Author

N88-29402*# Boeing Aerospace Co., Seattle, Wash.
A SPACE STATION ONBOARD SCHEDULING ASSISTANT c18
A. F. Brindle and B. H. Anderson *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 457-463 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 22B

One of the goals for the Space Station is to achieve greater autonomy, and have less reliance on ground commanding than previous space missions. This means that the crew will have to take an active role in scheduling and rescheduling their activities onboard, perhaps working from preliminary schedules generated on the ground. Scheduling is a time intensive task, whether performed manually or automatically, so the best approach to solving onboard scheduling problems may involve crew members working with an interactive software scheduling package. A project is described which investigates a system that uses knowledge based techniques for the rescheduling of experiments within the Materials Technology Laboratory of the Space Station. Particular attention is paid to: (1) methods for rapid response rescheduling to accommodate unplanned changes in resource availability, (2) the nature of the interface to the crew, (3) the representation of the many types of data within the knowledge base, and (4) the possibility of applying rule-based and constraint-based reasoning methods to onboard activity scheduling. Author

N88-29403*# Computer Sciences Corp., Huntsville, Ala.
NOA: A NETWORK OPERATOR ASSISTANT FOR SCHEDULING TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS) c63
Terry Janssen, Richard A. Berg, and Bikas K. Das *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 465-473 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Network Operator Assistant (NOA) is a prototype expert system. NOA uses detailed scheduling knowledge and problem solving heuristics to assist Network Control Center operators schedule the NASA Space Network in time critical situations. The current status of NOA and its future directions is presented. Author

N88-29404*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENT SCHEDULING FOR SPACELAB MISSIONS c81
John Jaap and Elizabeth Davis *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 475-488 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05A

The Experiment Scheduling Program (ESP) is the heart of a group of programs developed at NASA-Marshall to schedule the experiment activities of Spacelab and other Shuttle missions. Other

programs in the group either prepare input data for ESP or produce derivative information based on the schedule produced by ESP. The task of experiment scheduling can be simply stated as positioning the experiment activities in a mission to that they collect their desired data without interfering with other activities. The program's capabilities as seen by the user are described along with mission constraints the program handles, and how the expert system in the program handles these constraints. Author

N88-29405*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.
INTELLIGENT INTERFACE DESIGN AND EVALUATION c63
Frank L. Greitzer *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 489-496 Sponsored in part by Martin Marietta Denver Aerospace Independent Research and Development (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Intelligent interface concepts and systematic approaches to assessing their functionality are discussed. Four general features of intelligent interfaces are described: interaction efficiency, subtask automation, context sensitivity, and use of an appropriate design metaphor. Three evaluation methods are discussed: Functional Analysis, Part-Task Evaluation, and Operational Testing. Design and evaluation concepts are illustrated with examples from a prototype expert system interface for environmental control and life support systems for manned space platforms. Author

N88-29406*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE EMERGENCE OF MULTI-USER EXPERT SYSTEMS c63
Michael S. Freeman *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 497-501 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

There exists a set of problems for which the single user workstation is not a viable solution. In some cases, it may be necessary for the system to support numerous experts working on different aspects of a single logical activity concurrently. In others, the activity may extend over a prolonged period of time during which different experts will work on different phases of the project to produce a single integrated result. Another possibility is that the results produced by the expert system must be continuously available to some group other than that actively exercising the expert system. These are the types of applications which require multiuser expert systems. The nature of NASA tends to produce expert system domains which are inherently multiuser. It is these domains that this new class of expert systems has first been encountered. As expert systems move into the main stream of large scale engineering projects, these encounters will become more frequent. A need for expert system building tools which can accommodate the unique properties of these multiuser domains as they emerge is a problem which needs to be addressed as the current set of tools migrate to time sharing environments, and as new tools are developed. Author

N88-29407*# Boeing Aerospace Co., Huntsville, Ala. Space Station.
A ROBOTIC SYSTEM FOR AUTOMATION OF LOGISTICS FUNCTIONS ON THE SPACE STATION c63
J. C. Martin, R. B. Purves, R. N. Hosier, and B. A. Krein (Westinghouse Mfg. Systems and Technology Center, Columbia, Md.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 503-511 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Spacecraft inventory management is currently performed by the crew and as systems become more complex, increased crew time will be required to perform routine logistics activities. If future spacecraft are to function effectively as research labs and production facilities, the efficient use of crew time as a limited resource for performing mission functions must be employed. The use of automation and robotics technology, such as automated warehouse and materials handling functions, can free the crew from many logistics tasks and provide more efficient use of crew time. Design criteria for a Space Station Automated Logistics Inventory Management System is focused on through the design and demonstration of a mobile two armed terrestrial robot. The system functionally represents a 0 gravity automated inventory management system and the problems associated with operating in such an environment. Features of the system include automated storage and retrieval, item recognition, two armed robotic manipulation, and software control of all inventory item transitions and queries. Author

N88-29408*# Alabama Univ., Huntsville.
PERSONNEL OCCUPIED WOVEN ENVELOPE ROBOT c54
Francis Wessling, William Teoh, and M. Carl Ziemke *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 513-521 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

The Personnel Occupied Woven Envelope Robot (POWER) provides an alternative to extravehicular activity (EVA) of space suited astronauts and/or use of long slender manipulator arms such as are used in the Shuttle Remote Manipulator System. POWER provides the capability for a shirt sleeved astronaut to perform such work by entering a control pod through air locks at both ends of an inflated flexible bellows (access tunnel). The exoskeleton of the tunnel is a series of six degrees of freedom (Six-DOF) articulated links compressible to 1/6 of their fully extended length. The operator can maneuver the control pod to almost any location within about 50 m of the base attachment to the space station. POWER can be envisioned as a series of hollow Six-DOF manipulator segments or arms wherein each arm grasps the shoulder of the next arm. Inside the hollow arms ia a bellow-type access tunnel. The control pod is the fist of the series of linked hollow arms. The fingers of the fist are conventional manipulator arms under direct visual control of the nearby operator in the pod. The applications and progress to date of the POWER system is given. Author

N88-29409*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.
REMOTE SERVICING OF SPACE SYSTEMS c54
S. L. Collins and R. B. Purves *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 523-535 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

Space systems are difficult to maintain on orbit. The difficulty arises from the limited ability and availability of the astronaut work force in the hazardous space environment. Remote robotic manipulation can free the astronaut from the hazardous working environment while also increasing the work force. However, remote robotic servicing is not without its own set of problems and limitations, such as communication time delay and unstructured worksites. Tests and test equipment are described which are designed to increase the understanding of the remote servicing problems and to allow development of potential solutions. A half scale satellite mockup was developed for evaluating and improving upon the design of replaceable subsystems, such as batteries and electronic boxes. A servicer system, that includes a six degree of freedom PUMA 560 robot and interchangeable end effectors (tools), was developed to aid in driving out servicer design requirements. The results include the time delay impact on servicing timelines and requirements for the servicer system. Author

N88-29410*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.
A TELEOPERATED ROBOTIC MANIPULATOR SYSTEM FOR MATERIALS PROCESSING EXPERIMENT SERVICING c54
Steven Suchting, R. Byron Purves, Jeffrey L. Grover, and Roy Scruggs (Georgia Inst. of Tech., Atlanta.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence

for Space Applications Aug. 1988 p 537-542 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

In 1984 Congress authorized NASA to begin the Space Station Program, and requested that 10 percent of program funds be spent in implementing automation and robotics (A and R) on the Space Station. In response to that request, Boeing established several Independent Research and Development (IR and D) projects to explore possible uses for A and R on the Space Station. One of those projects, and automated materials processing experiment, is discussed. The project uses a teleoperated robot to demonstrate telescience applied to a Chemical Vapor Transport materials processing experiment. Author

N88-29411*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EXPERT SYSTEM FOR A DISTRIBUTED REAL-TIME TRAINER **c14**
Steven C. Purinton and Caroline K. Wang *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 545-554 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 14B

The problem addressed by this expert system concerns the expansion of capability of a Real Time Trainer for the Spacelab flight crew. As requirements for more models or fidelity are placed upon the system, expansion is necessary. The simulator can be expanded using a larger processor or by going to a distributed system and expand by adding additional processors. The distributed system is preferable because it is more economical and can be expanded in a more incremental manner. An expert system was developed to evaluate modeling and timing capability within a real time training simulator. The expert system is based upon a distributed configuration. Components of the modeled system are control tasks, network tasks, emulator tasks, processors, displays, and a network. The distributed module expert system (DMES) allows the configuring of processors, tasks, display use, keyboard use, and selection of alternate methods to update the data buffer. Modules can be defined with execution occurring in a specific processor on a network. The system consists of a knowledge front end editor to interactively generate or update the knowledge base, an inference engine, a display module, and a recording module. Author

N88-29412*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
UTILIZATION OF ARTIFICIAL INTELLIGENCE TECHNIQUES FOR THE SPACE STATION POWER SYSTEM **c63**
Thomas C. Evatt and Edward W. Gholdston *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 555-562 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Due to the complexity of the Space Station Electrical Power System (EPS) as currently envisioned, artificial intelligence/expert system techniques are being investigated to automate operations, maintenance, and diagnostic functions. A study was conducted to investigate this technology as it applies to failure detection, isolation, and reconfiguration (FDIR) and health monitoring of power system components and of the total system. Control system utilization of expert systems for load scheduling and shedding operations was also researched. A discussion of the utilization of artificial intelligence/expert systems for Initial Operating Capability (IOC) for the Space Station effort is presented along with future plans at Rocketdyne for the utilization of this technology for enhanced Space Station power capability. Author

N88-29413*# Mitre Corp., Houston, Tex.
A METHODOLOGY FOR MULTIPLE RULE SYSTEM INTEGRATION AND RESOLUTION WITHIN A SINGULAR KNOWLEDGE BASE **c63**
Frank N. Kautzmann, III *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 563-581 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

Expert Systems which support knowledge representation by qualitative modeling techniques experience problems, when called upon to support integrated views embodying description and explanation, especially when other factors such as multiple causality, competing rule model resolution, and multiple uses of knowledge representation are included. A series of prototypes are being developed to demonstrate the feasibility of automating the process of systems engineering, design and configuration, and diagnosis and fault management. A study involves not only a generic knowledge representation; it must also support multiple views at varying levels of description and interaction between physical elements, systems, and subsystems. Moreover, it will involve models of description and explanation for each level. This multiple model feature requires the development of control methods between rule systems and heuristics on a meta-level for each expert system involved in an integrated and larger class of expert system. The broadest possible category of interacting expert systems is described along with a general methodology for the knowledge representation and control of mutually exclusive rule systems. Author

N88-29414*# Martin Marietta Aerospace, Denver, Colo.
BLACKBOARD ARCHITECTURES AND THEIR RELATIONSHIP TO AUTONOMOUS SPACE SYSTEMS **c63**
Allison Thornbrugh *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 583-589 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The blackboard architecture provides a powerful paradigm for the autonomy expected in future spaceborne systems, especially SDI and Space Station. Autonomous systems will require skill in both the classic task of information analysis and the newer tasks of decision making, planning and system control. Successful blackboard systems have been built to deal with each of these tasks separately. The blackboard paradigm achieves success in difficult domains through its ability to integrate several uncertain sources of knowledge. In addition to flexible behavior during autonomous operation, the system must also be capable of incrementally growing from semiautonomy to full autonomy. The blackboard structure allows this development. The blackboard's ability to handle error, its flexible execution, and variants of this paradigm are discussed as they apply to specific problems of the space environment. Author

N88-29415*# Martin Marietta Aerospace, Denver, Colo.
DESIGN CONSIDERATION IN CONSTRUCTING HIGH PERFORMANCE EMBEDDED KNOWLEDGE-BASED SYSTEMS (KBS) **c63**
Shelly D. Dalton and Philip C. Daley *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 591-596 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

As the hardware trends for artificial intelligence (AI) involve more and more complexity, the process of optimizing the computer system design for a particular problem will also increase in complexity. Space applications of knowledge based systems (KBS) will often require an ability to perform both numerically intensive vector computations and real time symbolic computations. Although parallel machines can theoretically achieve the speeds necessary for most of these problems, if the application itself is not highly parallel, the machine's power cannot be utilized. A scheme is presented which will provide the computer systems engineer with a tool for analyzing machines with various configurations of array, symbolic, scaler, and multiprocessors. High speed networks and interconnections make customized, distributed, intelligent systems feasible for the application of AI in space. The method presented can be used to optimize such AI system configurations and to make comparisons between existing computer systems. It is an

open question whether or not, for a given mission requirement, a suitable computer system design can be constructed for any amount of money. Author

N88-29416*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Software Technology Center.

VALIDATION OF EXPERT SYSTEMS **c63**

Rolf A. Stachowitz and Jacqueline B. Combs *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 597-606 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

The validation of expert systems (ESs) has only recently become an active AI research topic. Current approaches have concentrated mainly on the validation of rule properties of such systems. The efforts presented improves on current methods by also exploiting the structural and semantic information of such systems. To increase programmer productivity, more and more companies have begun exploiting the advent of AI technology by developing applications using ES shells or other AI-based high level program generators. The architecture, functionality, and future goals of Expert Systems Validation are described along with the features that have been implemented for and in Automated Reasoning Tool, the ES shell presented. Author

N88-29417*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.

A NONLINEAR FILTERING PROCESS DIAGNOSTIC SYSTEM FOR THE SPACE STATION

Raymond R. Yoel, M. Buchner, K. Loparo, and Arif Cubukcu (Case Western Reserve Univ., Cleveland, Ohio.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 601-604 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

A nonlinear filtering process diagnostic system, terrestrial simulation and real time implementation studies is presented. Possible applications to Space Station subsystem elements are discussed. A process diagnostic system using model based nonlinear filtering for systems with random structure was shown to provide improvements in stability, robustness, and overall performance in comparison to linear filter based systems. A suboptimal version of the nonlinear filter (zero order approximation filter, or ZOA filter) was used in simulation studies, initially, with a pressurized water reactor model and then with water/steam heat exchanger models. Finally, a real time implementation for leak detection in a water/steam heat exchanger was conducted using the ZOA filter and heat exchanger models. Author

N88-29418*# Westinghouse Research and Development Center, Pittsburgh, Pa.

MATHEMATICAL ALGORITHMS FOR APPROXIMATE REASONING Abstract Only

John H. Murphy, Seung C. Chay, and Mary M. Downs *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 605-606 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

Most state of the art expert system environments contain a single and often ad hoc strategy for approximate reasoning. Some environments provide facilities to program the approximate reasoning algorithms. However, the next generation of expert systems should have an environment which contain a choice of several mathematical algorithms for approximate reasoning. To meet the need for validatable and verifiable coding, the expert system environment must no longer depend upon ad hoc reasoning techniques but instead must include mathematically rigorous techniques for approximate reasoning. Popular approximate reasoning techniques are reviewed, including: certainty factors, belief measures, Bayesian probabilities, fuzzy logic, and Shafer-Dempster techniques for reasoning. A group of mathematically rigorous algorithms for approximate reasoning are focused on that could form the basis of a next generation expert system environment. These algorithms are based upon the axioms of set theory and probability theory. Author

N88-29419*# LISP Machines, Inc., Los Angeles, Calif.

REAL-TIME SPACE SYSTEM CONTROL WITH EXPERT SYSTEMS **c18**

David Leinweber, Lowell Hawkinson, and John Perry (OAO Corp., Los Angeles, Calif.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 607-609 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 22B

Many aspects of space system operations involve continuous control of real time processes. These processes include electrical power system monitoring, prelaunch and ongoing propulsion system health and maintenance, environmental and life support systems, space suit checkout, onboard manufacturing, and vehicle servicing including satellites, shuttles, orbital maneuvering vehicles, orbital transfer vehicles and remote teleoperators. Traditionally, monitoring of these critical real time processes has been done by trained human experts monitoring telemetry data. However, the long duration of future space missions and the high cost of crew time in space creates a powerful economic incentive for the development of highly autonomous knowledge based expert control procedures for these space systems. Author

N88-29420*# Alabama Univ., Birmingham.

A FLEXIBLE SEARCH STRATEGY FOR PRODUCTION SYSTEMS Abstract Only

Pradip Dey, S. Srinivasan, and K. R. Sundararaghavan *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 611 (For primary document see N88-29351 23-61)

Avail: NTIS HC A99/MF E03 CSCL 09B

Most problems considered to be solvable by expert systems have very large search space. It is imperative to use efficient search strategy in expert system tools. Thus, OPS5 uses a kind of hill climbing which is very efficient. However, hill climbing is inadequate for many problems because it is one of the least dependable search strategies. In order to make the search efficient and adequate one can: (1) adopt best-first search instead of hill climbing, or (2) modify hill climbing with intelligent backtracking. The second alternative is adopted. It is implemented in a production system called PRO2 embedded in C running on UNIX. It is called hill tracking. It is a general purpose tool for developing expert systems. This is a rule based production system with an effective, intelligent and flexible backtracking control mechanism, which makes the system more dependable. The advantages and disadvantages of PRO2 are discussed. Author

N88-29421*# Tennessee Univ. Space Inst., Tullahoma. Knowledge Engineering Lab.

SEMANTIC BASED MAN-MACHINE INTERFACE FOR REAL-TIME COMMUNICATION Abstract Only **c54**

M. Ali and C.-S. Ai *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 613 (For primary document see N88-29351 23-61)

(Grant NAG1-513)

Avail: NTIS HC A99/MF E03 CSCL 05H

A flight expert system (FLES) was developed to assist pilots in monitoring, diagnosing and recovering from in-flight faults. To provide a communications interface between the flight crew and FLES, a natural language interface (NALI) was implemented. Input to NALI is processed by three processors: (1) the semantics parser; (2) the knowledge retriever; and (3) the response generator. First the semantic parser extracts meaningful words and phrases to generate an internal representation of the query. At this point, the semantic parser has the ability to map different input forms related to the same concept into the same internal representation. Then the knowledge retriever analyzes and stores the context of the query to aid in resolving ellipses and pronoun references. At the

end of this process, a sequence of retrievel functions is created as a first step in generating the proper response. Finally, the response generator generates the natural language response to the query. The architecture of NALI was designed to process both temporal and nontemporal queries. The architecture and implementation of NALI are described. Author

N88-29422*# Gold Hill Computers, Inc., Cambridge, Mass.
THE CONCURRENT COMMON LISP DEVELOPMENT ENVIRONMENT Abstract Only
In NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 615-616 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A discussion of the Concurrent Common Lisp Development Environment on the iNTEL Personal Super Computer (iPSC) is presented. The advent of AI based engineering design tools has lead to a need for increased performance of computational facilities which support those tools. Gold Hill has approached this problem by directing its efforts to the creation of a concurrent, distributed AI development environment. This discussion focuses on the development tools aspect of the CCLISP environment. The future direction of Gold Hill in the area of distributed AI support environments is also presented. Author

N88-29423*# Inference Corp., Los Angeles, Calif.
AUTOMATED SOFTWARE DEVELOPMENT WORKSTATION
Dale A. Prouty and Philip Klahr *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 617-619 (For primary document see N88-29351 23-61)
(Contract NAS9-17515)
Avail: NTIS HC A99/MF E03 CSCL 09B

A workstation is being developed that provides a computational environment for all NASA engineers across application boundaries, which automates reuse of existing NASA software and designs, and efficiently and effectively allows new programs and/or designs to be developed, catalogued, and reused. The generic workstation is made domain specific by specialization of the user interface, capturing engineering design expertise for the domain, and by constructing/using a library of pertinent information. The incorporation of software reusability principles and expert system technology into this workstation provide the obvious benefits of increased productivity, improved software use and design reliability, and enhanced engineering quality by bringing engineering to higher levels of abstraction based on a well tested and classified library. Author

N88-29424*# Digital Equipment Corp., Atlanta, Ga.
AI TOOLS IN COMPUTER BASED PROBLEM SOLVING Abstract Only **c63**
Arthur J. Beane *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 621 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The use of computers to solve value oriented, deterministic, algorithmic problems, has evolved a structured life cycle model of the software process. The symbolic processing techniques used, primarily in research, for solving nondeterministic problems, and those for which an algorithmic solution is unknown, have evolved a different model, much less structured. Traditionally, the two approaches have been used completely independently. With the advent of low cost, high performance 32 bit workstations executing identical software with large minicomputers and mainframes, it became possible to begin to merge both models into a single extended model of computer problem solving. The implementation of such an extended model on a VAX family of micro/mini/mainframe systems is described. Examples in both development and deployment of applications involving a blending of AI and traditional techniques are given. Author

N88-29425*# Gold Hill Computers, Inc., Cambridge, Mass.
NETWORKING AND AI SYSTEMS: REQUIREMENTS AND BENEFITS Abstract Only **c63**
In NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 623-624 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The price performance benefits of network systems is well documented. The ability to share expensive resources sold timesharing for mainframes, department clusters of minicomputers, and now local area networks of workstations and servers. In the process, other fundamental system requirements emerged. These have now been generalized with open system requirements for hardware, software, applications and tools. The ability to interconnect a variety of vendor products has led to a specification of interfaces that allow new techniques to extend existing systems for new and exciting applications. As an example of the message passing system, local area networks provide a testbed for many of the issues addressed by future concurrent architectures: synchronization, load balancing, fault tolerance and scalability. Gold Hill has been working with a number of vendors on distributed architectures that range from a network of workstations to a hypercube of microprocessors with distributed memory. Results from early applications are promising both for performance and scalability. Author

N88-29426*# Digital Equipment Corp., Atlanta, Ga.
AN EXPERT SYSTEM FOR NATURAL LANGUAGE PROCESSING
John F. Hennessy *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 625-630 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

A solution to the natural language processing problem that uses a rule based system, written in OPS5, to replace the traditional parsing method is proposed. The advantage to using a rule based system are explored. Specifically, the extensibility of a rule based solution is discussed as well as the value of maintaining rules that function independently. Finally, the power of using semantics to supplement the syntactic analysis of a sentence is considered. Author

N88-29427*# Digital Equipment Corp., Atlanta, Ga.
EXPERT SYSTEM TECHNOLOGY AS A DATA PROCESSING TOOL
John F. Hennessy *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 631-636 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

The expert system technology is focused on as a data processing tool. Several existing applications are analyzed. Their original definition as pure expert systems is contrasted with their current status as integrated systems. The architectural requirements needed to support such a heterogeneous environment are given. Author

N88-29428*# Martin Marietta Aerospace, Denver, Colo. Advanced Automation Technology (Robotics) Group.
NEXT-GENERATION SPACE MANIPULATOR **c54**
P. Brunson, W. Chun, and P. Cogeos *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 637-646 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05H

In 1977, the Protoflight Manipulator Arm (PFMA) was designed and built. It is one of two space qualified manipulators. A new conceptual design for the next generation manipulator of space applications is presented. The next generation manipulator and the PFMA are described in detail. Their differences could have a major influence on the construction, testing, and performance of a space arm. Assessed in detail are these technologies and their

effect on the design. Servicing is an important goal of robotics in space. Parameters such as environment, type of task, time sequence, and dexterity will affect the arm and its ability to accomplish its mission. Requirements such as these are important considerations in the design of the next generation space arm.
Author

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-29429# Colorado Univ., Boulder. Computer Systems Design Group.
THE FORCE Interim Report
Harry Jordan Jan. 1987 44 p
(Contract N00014-86-K-0204; Grant AF-AFOSR-1089-85)
(AD-A193463; CSDG-87-1; ECE-TR-87-1-1) Avail: NTIS HC A03/MF A01 CSCL 09B

The FORCE is a parallel programming language and methodology based on the shared memory multiprocessor model of computation. It is an extension to FORTRAN which allows a user to write a parallel program which is independent of the number of processes executing it and in which the management of processes is suppressed. Multiple instruction streams are managed as a group by operations which synchronize them and allocate work. The system is implemented on several machines as a macro preprocessor which expands FORCE programs into FORTRAN code for the host system.
GRA

N88-29430# Colorado Univ., Boulder. Computer Systems Design Group.
PROGRAMMING LANGUAGE CONCEPTS FOR MULTIPROCESSORS Interim Report
Harry F. Jordan Sep. 1987 14 p
(Contract N00014-86-K-0204)
(AD-A193465; CSDG-87-4; ECE-TR-87-1-3) Avail: NTIS HC A03/MF A01 CSCL 12E

It is currently possible to build multiprocessor systems which will support the tightly coupled activity of hundreds to thousands of different instruction streams, or processes. This can be done by coupling many monoprocessors, or a smaller number of pipelined multiprocessors, through a high concurrency switching network. The switching network may be couple processors to memory modules, resulting in a shared memory multiprocessor system, or it may be couple processor to memory pairs, resulting in a distributed memory system. The need to direct the activity of very many processes simultaneously places qualitatively different demands on a programming language than the direction of a single process. In spite of the different requirements, most languages for multiprocessors have been simple extensions of conventional, single stream programming languages. The extensions are often implemented by way of subroutine calls and have little impact on the basic structure of the language. This paper attempts to examine the underlying conceptual structure of parallel languages for large scale multiprocessors on the basis of an existing language for shared memory multiprocessors, known as the FORCE, and to extend the concepts in this language to distributed memory systems.
GRA

N88-29431*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
ADVANCED INFORMATION PROCESSING SYSTEM: INPUT/OUTPUT NETWORK MANAGEMENT SOFTWARE
Gail Nagle, Linda Alger, and Alexander Kemp May 1988 288 p
(Contract NAS1-17666)
(NASA-CR-181678; NAS 1.26:181678) Avail: NTIS HC A13/MF A01 CSCL 09B

The purpose of this document is to provide the software requirements and specifications for the Input/Output Network Management Services for the Advanced Information Processing System. This introduction and overview section is provided to briefly outline the overall architecture and software requirements of the AIPS system before discussing the details of the design requirements and specifications of the AIPS I/O Network Management software. A brief overview of the AIPS architecture followed by a more detailed description of the network architecture.
Author

N88-29432# Michigan State Univ., East Lansing. Dept. of Computer Science.
LARGE-GRAIN PIPELINING ON DISTRIBUTED-MEMORY MULTIPROCESSORS
Chung-Ta King, Wen-Hwa Chou, and L. M. Ni 1988 8 p
Presented at the 3rd International Conference on Supercomputing, Boston, Mass., 15 May 1988 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-009974; CONF-880567-5; CONF-880567) Avail: NTIS HC A02

The distributed nature of distributed-memory multiprocessors increases the system's extendibility and modularity. However, it also introduces communication difficulties (em dash) data must be moved around explicitly among the processors in the system. In this paper, the concept of large-grain pipelining is introduced, which attempts to maximize the overlapping within the system to minimize the effects of communication overhead. The basic idea is to regulate the information flows in the system in a pipelined fashion. The concept is contrasted with that of systolic arrays, and a general procedure is outlined which transform a systolic algorithm into an algorithm using large-grain pipelining. An analytic model was developed, which not only assists in determining optimal design in a more formal way. Predicted performance from the analytic model matches closely with experimental results obtained from a 64-node NCUBE, and both confirm the effectiveness of large-grain pipelining.
DOE

N88-29433# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A PERFORMANCE STUDY OF THE HYPERCUBE ARCHITECTURE M.S. Thesis
Catherine A. Lamanna Jun. 1988 116 p
(AD-A194361; AFIT/GCS/ENG/88J-1) Avail: NTIS HC A06/MF A01 CSCL 12F

The relationship between workload characteristics and process speedup is investigated. There were two goals: the first was to determine the functional relationship between workload characteristics and speedup, and the second was to show how simulation could be used to determine such a relationship. The hypercube implementation used in this study is a packet-switched network with predetermined routing. Message processing has precedence, so nodes are interrupted during task processing. Three independent variables were controlled: total computational workload, number of nodes and the message traffic load. The workload was assumed to be balanced across the nodes. A benchmark program was executed on an actual hypercube and the results were used to validate a discrete event simulation model of hypercube processing. Using the simulation, an experiment was designed to control the total computational load over two levels, the number of nodes over five levels and the message traffic load over four levels to determine their individual and interactive effects on process speedup.
GRA

N88-29434# Ohio State Univ., Columbus.
PARALLEL REAL-TIME EXPERT SYSTEMS Final Report, 11 Nov. 1986 - 30 Apr. 1988
B. Chandrasekaran and Karsten Schwan 20 Feb. 1988 5 p
(Grant AF-AFOSR-0076-87)
(AD-A193673; AFOSR-88-0558TR) Avail: NTIS HC A02/MF A01 CSCL 12F

Work done under a grant issued through the University Research Instrumentation Program is summarized. The grant was issued to support the purchase of parallel processing equipment to conduct experimental research in high-speed real-time decision

making by parallelism. The facilities were used to understand the software requirements of real-time systems, such as complex robotics systems. GRA

N88-29435# Hatfield Polytechnic (England).
OPTIMISATION ALGORITHMS FOR HIGHLY PARALLEL COMPUTER ARCHITECTURES. THE PERFORMANCE OF THE TRUNCATED NEWTON, CONJUGATE GRADIENT ALGORITHM IN FORTRAN AND Ada Interim Report No. 2
L. C. Dixon and Z. A. Maany Mar. 1988 25 p
(Contract DAJA45-87-C-0038)
(AD-A193940) Avail: NTIS HC A03/MF A01 CSCL 12F

This project is concerned with the optimization of objective functions F(x) in a large dimensional space R to the n power on highly parallel computers. It has been established that the truncated Newton method introduced by Dembo and Steihang is an efficient method for solving large optimization algorithms on a sequential machine, Dixon and Price. The truncated Newton method consists of two main steps: (1) the calculation of the function value F(x), gradient vector g(x) and Hessian matrix H(x) at a sequence of points x to the (k) power, and (2) solving the set of linear equations $H(x)\ d = -\ g(x)$ approximately for the search direction d. GRA

N88-29436# Royal Signals and Radar Establishment, Malvern (England).
RADIAL BASIS FUNCTIONS, MULTI-VARIABLE FUNCTIONAL INTERPOLATION AND ADAPTIVE NETWORKS
D. S. Broomhead and D. Lowe 28 Mar. 1988 39 p
(RSRE-Memo-4148; BR106143; ETN-88-93136) Copyright
Avail: NTIS HC A03/MF A01

The relationship between learning in adaptive layered networks and the fitting of data with high dimensional surfaces is discussed. This leads to a picture of generalization in terms of interpolation between known data points and suggests a rational approach to the theory of such networks. A class of adaptive networks which makes the interpolation scheme explicit is identified. This class has the property that learning is equivalent to the solution of a set of linear equations. These networks thus represent nonlinear relationships while having a guaranteed learning rule. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-29437 Georgia Inst. of Tech., Atlanta.
IDENTIFICATION AND CONTROL OF TIME-VARYING FLEXIBLE STRUCTURES: AN ARTIFICIAL INTELLIGENCE APPROACH Ph.D. Thesis
Brian Jay Glass 1987 217 p
Avail: Univ. Microfilms Order No. DA8800032

A form of explicit self-tuning adaptive control called controller model replacement (CMR) was developed for flexible structures whose boundary conditions and parameters vary discontinualiy over time (TVFS). This control has incorporated a process of model identification as well as the use of parameter identification methods. Model identification was approached by the use of the artificial intelligence methods of heuristic search, discrimination nets, frames, and knowledge structuring. An object-oriented programming approach was used to implement the latter three methods. Numerical parameter identification followed model identification to refine newly-identified models. For convergence to occur, it was found that the initial parameter errors must be sufficiently small and bounded. Linear optimal output feedback controls for the newly-identified models were designed using an existing method. Comparisons of closed-loop eigensolutions, optimal gains, and damping were made with an adaptive control which uses only parameter identification, as well as with a fixed controller based on the initial model. An example of model space of beams, based on boundary condition and payload changes to a single-link manipulator, was used to illustrate identification and control procedures. It was found that the use of AI-based model identification allowed the identification process to follow sudden model changes significantly better than the use of parameter identification alone. Correspondingly, the use of model identification in adaptation led to control gains which were closer to those of the actual model, and hence to improved damping and closed-loop eigenvalues. Dissert. Abstr.

N88-29438# Syracuse Univ., N. Y. School of Computer and Information Science.
THE COMPLEXITY OF AI ALGORITHMS Final Technical Report, May 1985 - Mar. 1987
C. R. Hartmann, P. K. Varshney, M. Ben-Jacob, C. Heinbach, and O. Murphy Sep. 1987 80 p
(Contract F30602-81-C-0193)
(AD-A193494; RADC-TR-87-132) Avail: NTIS HC A05/MF A01 CSCL 12E

This report contains the results of two efforts both focused on the resolution algorithm which is particularly well suited for automation on computers, and is one of the leading mechanisms used in automatic theorem proving. It can also be used in the deductive engine of an expert system. The deductive engine is an important component of any expert system. The first effort examined the complexity of logic programming and showed that the logic programming problem is NP-hard. This result motivated us to look at preprocessing techniques that allow part of the time cost to be paid beforehand. Several preprocessing techniques we proposed offer a decrease in time cost at the expense of storage. The second effort investigates the relationship between input and unit resolution for Horn clause systems. A measure of non-linearity is given for unit refutations and establish that this measure has no upper bound over the set of unit refutations. GRA

N88-29439# Integrated Systems, Inc., Santa Clara, Calif.
COMPUTER-AIDED-CONTROL ENGINEERING (CACE) PRIMITIVES FOR ROBUST AND ADAPTIVE CONTROL SYSTEMS, PHASE 1 Final Technical Report, Aug. 1986 - Feb. 1987
Robert L. Kosut and M Vidyasagar 12 Oct. 1987 50 p
(Contract F49620-86-C-0100)
(AD-A192446; ISI-108; AFOSR-87-2024TR) Avail: NTIS HC A03/MF A01 CSCL 09B

The objective of the past research was the development of some mathematical and computational tools that are appropriate to the next generation of CACE (Computer Aided Control Engineering) environments. These CACE packages will be radically different than the present analysis packages in that they will truly be able to perform control system synthesis. In order for this ideal situation to come about, it is necessary first to solve some important problems in the mathematics of control systems as well as in computational techniques. Phase 1 of the research program addressed the feasibility of solving some of the problems. Phase 2 will extend the results of Phase 1 as well as developing primitives for performing robust and adaptive control design. In particular, we will address the following control problems: (1) synthesis of linear control systems, (2) analysis of transfer function estimation, (3) analysis of parameter adaptive control, and (4) language architecture for control design. Author

N88-29440 Essex Univ., Colchester (England).
A MODEL OF INFORMATION GROWTH Ph.D. Thesis
Nadim Obeid 1987 113 p
Avail: Univ. Microfilms Order No. BRD-80234

It is beyond controversy that reasoning about knowledge and belief is a major research issue in Artificial Intelligence (AI). It is also notable that a study of knowledge/belief is included in any AI system irrespective of its aims and motivations. Therefore, for any AI system to have some degree of flexibility, generality, and extendability, it must somehow embody some knowledge about how knowledge/belief can be represented, used, and possibly revised. A model is introduced, called a model of information growth, which aims at capturing the activity of a rational agent

capable of drawing some conclusions from incomplete and/or imprecise information about the domain of concern. The main components of the model consist of a state representing what the agent accepts at a certain moment, an accessibility relation which determines the set of states which the agent considers possible and a change function which represents its revision policies. The model is introduced, its general features and some of the particular choices that are made regarding different concepts such as truth vis-a-vis acceptance and conditionals vis-a-vis acceptance-conditionals, are discussed. The non-monotonic logics presented are extended with a notion of conditionals in order to represent the agent revision strategies. A comparison with Lewis and Stalnaker conditionals is made. The model is useful at both theoretical and practical levels. Its applications include any branch or area of research in AI that requires reasoning about knowledge and belief. Dissert. Abstr.

N88-29441# Honeywell Systems and Research Center, Minneapolis, Minn.
ROBUST CONTROL OF MULTIVARIABLE AND LARGE SCALE SYSTEMS Final Report, Oct. 1985 - Mar. 1988
Andrew Packard and John C. Doyle 23 Mar. 1988 117 p
(Contract F49620-86-C-0001)
(AD-A194250; Rept-88SRC11; AFOSR-88-0450TR) Avail: NTIS HC A06/MF A01 CSCL 12C

This report gives a fairly complete introduction to the Structured Singular Value (mu) and details some of the latest results. The mu-based methods discussed here have proven to be useful for analyzing the performance and robustness properties of linear feedback systems. This report also describes the recent nonlinear extensions. A description is given for how parametric uncertainty in state space models can be rearranged into the mu framework. The theories for computation of the upper and lower bounds on mu are developed. The relationships between the upper bound and mu for various block structures are explored. The extensions of the mu-based methods to time-varying and nonlinear controllers are outlined. GRA

N88-29442# Brown Univ., Providence, R. I. Center for Dynamical Systems.
CONVEX DUALITY APPROACH TO THE OPTIMAL CONTROL OR DIFFUSIONS
Wendell H. Fleming and Domokos Vermes Jan. 1988 30 p
(Contracts N00014-83-K-0542; F49620-86-C-0111; Grants AF-AFOSR-0315-85; NSF MCS-81-21940)
(AD-A194535; LCDS/CCS-88-2; AFOSR-88-0389TR) Avail: NTIS HC A03/MF A01 CSCL 12D

Partial contents of: the weak formulation of the problem; duality and the Hamilton-Jacobi problem; equivalence of the Strong and weak formulations; a Sobolev approximation of the value function; Semi-continuous costs; and inclusion of terminal penalties are considered. GRA

N88-29443# Columbia Univ., New York, N.Y.
TOPICS IN ADAPTIVE CONTROL AND INFERENCE Final Report, 1 Apr. 1985 - 1 Apr. 1988
Herbert Robbins and Tze L. Lai Apr. 1988 4 p
(Contract DAAG29-85-K-0088)
(AD-A194718; ARO-21382.8-MA) Avail: NTIS HC A02/MF A01 CSCL 12C

Research was conducted in the fields of adaptive filtering and control, dynamic allocation and the multi-armed bandit problem, stochastic approximation, stochastic search, sequential analysis, and empirical Bayes methodology. In adaptive filtering and control, we developed asymptotically efficient simple recursive filters and control schemes for linear dynamic systems where certain parameters in the signal and noise models are unknown. In particular, asymptotic efficiency was achieved in adaptive control by resolving the apparent dilemma between information and control. To resolve this dilemma, considerable insight was provided by several recent breakthroughs in adaptive learning theory and the classical multi-armed bandit problem. We also worked on the development of adaptive learning algorithms and adaptive allocation rules, and studied their applications to a variety of problems. Applications of the methodology of stochastic approximation to stochastic control and to stochastic optimization of constrained and unconstrained systems were also investigated. Motivated by applications to sampling inspection and quality control, we also developed a general theory of sequential analysis in the framework of dependent variables and composite hypotheses. In addition, empirical Bayes methods and semiparametric methods in estimation were studied, and stochastic search strategies for tracking mobile targets were developed. GRA

N88-29444# Naval Postgraduate School, Monterey, Calif.
ADAPTIVE IDENTIFICATION BY SYSTOLIC ARRAYS M.S. Thesis
Paul A. Willis Dec. 1987 69 p
(AD-A193532) Avail: NTIS HC A04/MF A01 CSCL 12D

This thesis is concerned with the implementation of an adaptive identification algorithm using parallel processing and systolic arrays. In particular, discrete samples of input and output data of a system with uncertain characteristics are used to determine the parameters of its model. The identification algorithm is based on recursive least squares, QR decomposition, and block processing techniques with covariance resetting. Along similar lines as previous approaches, the identification process is based on the use of Givens rotations. This approach uses the Cordic algorithm for improved numerical efficiency in performing the rotations. Additionally, floating point and fixed point arithmetic implementations are compared. GRA

N88-29445# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering and Computer Science.
LINEARIZED MODEL MATCHING FOR SINGLE-IMPUT NONLINEAR SYSTEMS Technical Report, 1 Mar. 1987 - 29 Feb. 1988
Wilson J. Rugh 1 Mar. 1988 13 p
(Grant AF-AFOSR-0101-87)
(AD-A193642; AFOSR-88-0437TR) Avail: NTIS HC A03/MF A01 CSCL 12F

In recent years there has been rapid development of the closely-related pseudo-linearization and extended linearization approaches for design of nonlinear control laws for nonlinear systems. This paper adopts a frequency-domain viewpoint, and uses results in an earlier document to formulate and solve a linearized model matching problem for single-input, multi-output nonlinear systems. The objective is to construct a nonlinear, dynamic, output feedback control law so that the resulting closed-loop system, when linearized about its family of constant operating points, has a linearization family with transfer function that matches exactly a given parameterized transfer function. If the given transfer function is parameter independent, then this problem can be viewed as a type of input-output pseudo-linearization problem. GRA

N88-29446# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.
ON THE DESIGN AND OPTIMIZATION OF DISTRIBUTED SIGNAL DETECTION AND PARAMETER ESTIMATION SYSTEMS Final Technical Report, Jun. 1984 - Dec. 1986
Imad Y. Hoballah and Pramod K. Varshney Sep. 1987 213 p
(Contract F30602-81-C-0169)
(AD-A193934; RADC-TR-87-130) Avail: NTIS HC A10/MF A01 CSCL 12I

In this report, the problems of hypothesis testing and parameter estimation in a distributed framework are considered. First, hypothesis testing in distributed systems with data fusion is treated. The approach can easily be applied to decentralized systems without data fusion. Optimal decision rules at the detectors and optimal fusions rules are derived for the distributed hypothesis testing problems using the Neyman-Pearson criterion, the general Bayesian criterion and the minimum equivocation criterion. Correspondence between information theory and detection theory is established. Decentralized postdetection integration problems are also considered and optimum fusion rules, as well as optimum

decision rules at the individual detectors are obtained for two proposed schemes. Next, decentralized Bayesian parameter estimation is considered and optimum estimation rules at the local estimators and optimum combining rules are obtained for the minimum mean square error criterion, the absolute error criterion and the uniform cost function criterion. GRA

N88-29447# Sanders Associates, Inc., Nashua, N. H.
ARTIFICIAL INTELLIGENCE SOFTWARE ACQUISITION PROGRAM, VOLUME 1 Final Technical Report, Aug. 1985 - Aug. 1987
Carol Bardawil, Larry Fry, Sandy King, Linda Leszcynski, and Graham ONeil Dec. 1987 202 p
(Contract F30602-85-C-0254)
(AD-A194104; RADC-TR-87-249-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 12E

The goal of this research was to evaluate the software development process for artificial intelligence systems and postulate a software acquisition model. To accomplish this, the major elements performed were a literature search, a case study analysis of 26 knowledge based system (KBS) development efforts, and consultation with experienced AI system developers. The results of this study are presented in a two volume report. Volume 1 presents observations made during the analysis of KBS software developments and provides summaries of the case study data. A comparison of the KBS development process to DOD-STD-2167 is also documented. Volume 2 discusses a KBS process model and customer/developer interface model. A comparison of the postulated model with DOD-STD-2167 and DOD-STD-2167A (draft) is made in terms of activities, products, reviews and baselines. GRA

N88-29448# Army Armament Research, Development and Engineering Center, Watervliet, N.Y.
DESIGN OF A FEELING-THINKING MACHINE Final Technical Report
Raymond Scanlon and Mark Johnson Mar. 1988 27 p
(AD-A194107; ARCCB-TR-88013) Avail: NTIS HC A03/MF A01 CSCL 23C

Machine intelligence for autonomous systems must be capable of learning and especially thinking, if we are to go beyond the 'islands of autonomy' presently envisioned for teleoperated and remotely piloted vehicles. One approach is to use the mammalian brain as a model and investigate the possibility of duplicating its functions in electronic circuitry. This extension of neural network design is called non-living intelligence (NLI). The brain consists of approximately 10 to the 12th power neurons intricately interconnected. Only a small part of this circuitry has been unravelled. The NLI effort at Benet Laboratories does not describe how the brain works, but involves electronic and computational experiments that provide insight into how the brain might work. We pursue NLI through the design and construction of feeling-thinking machines. Feeling is essential because without motivation, there is nothing. The machine must want to do things. In doing things, it will learn; and having learned, it will think. This report does not describe machines that exhibit intelligent behavior; but rather machines that feel, want, and think. The distant goal is to create a machine that thinks and acts like a human. This report discusses the first of a series of feeling-thinking machine designs. GRA

N88-29449# Societe Nationale Industrielle Aerospatiale, Paris (France).
CONTRIBUTION OF EXPERT SYSTEMS TO AVIONICS ADVANCE. APPLICATION ON AS30 LASER WEAPON SYSTEM
Serge Dupuy 1988 8 p
(SNIAS-881-320-103; ETN-88-92845) Avail: NTIS HC A02/MF A01

Artificial intelligence and expert systems are introduced. The interest and difficulties relating to this technique are exposed. An example of expert system development for AS30L weapon system illustrates the points stated. Prospects of this technique for avionics are assessed. ESA

N88-29358*# Alabama Univ., Huntsville. Dept. of Management Information Systems and Management Science.
A KNOWLEDGE-BASED DECISION SUPPORT SYSTEM FOR PAYLOAD SCHEDULING
Stephen Floyd and Donnie Ford *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 69-78 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29359*# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ARTIFICIAL INTELLIGENCE APPLIED TO PROCESS SIGNAL ANALYSIS
Dan Corsberg *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 79-84 Previously announced as N88-70717 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29362*# Cincinnati Univ., Ohio. Dept. of Electrical and Computer Engineering.
AN APPROACH TO COMBINING HEURISTIC AND QUALITATIVE REASONING IN AN EXPERT SYSTEM
Wei-Si Jiang, Chia Yung Han, Lian Cheng Tsai, and William G. Wee *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 105-110 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29363*# Alabama Univ., Huntsville. Dept. of History and Philosophy.
EXPERTISE AND REASONING WITH POSSIBILITY: AN EXPLANATION OF MODAL LOGIC AND EXPERT SYSTEMS
Daniel Rochowiak *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 111-115 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29364*# BDM Corp., Huntsville, Ala.
ANALYST-CENTERED MODELS FOR SYSTEMS DESIGN, ANALYSIS, AND DEVELOPMENT
A. P. Bukley, Richard H. Pritchard, Steven M. Burke, and P. A. Kiss *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 117-121 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29368*# Alabama Univ., Huntsville. Dept. of Computer Science.
AUTOMATIC OBJECT RECOGNITION
H. S. Ranganath, Pat McIngvale, and Heinz Sage (Army Missile Command, Redstone Arsenal, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 157-166 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29369*# TREC, Inc., Huntsville, Ala.
TWO DIMENSIONAL CONVOLUTE INTEGERS FOR MACHINE VISION AND IMAGE RECOGNITION Abstract Only
Thomas R. Edwards *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 167 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29370*# Boeing Computer Support Services, Inc., Huntsville, Ala.
FAILURE MODES AND EFFECTS ANALYSIS AUTOMATION
Cynthia H. Kamhieh, Dannie E. Cutts, and R. Byron Purves (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space

Applications Aug. 1988 p 169-176 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29371*# Vanderbilt Univ., Nashville, Tenn.
INTELLIGENT TEST INTEGRATION SYSTEM
J. Sztipanovits, S. Padalkar, J. Rodriguez-Moscoso, K. Kawamura, B. Purves, R. Williams, and H. Biglari (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 177-185 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29372*# General Research Corp., Huntsville, Ala.
ON RECOGNIZING IGNORANCE
Richard J. Greene *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 187-191 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29373*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DAISY-DAMP: A DISTRIBUTED AI SYSTEM FOR THE DYNAMIC ALLOCATION AND MANAGEMENT OF POWER
Steven B. Hall and Peter C. Ohler *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 201-208 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29386*# Boeing Co., Seattle, Wash. Intelligent Robotics and Perception.
DISTRIBUTED COOPERATING PROCESSES IN A MOBILE ROBOT CONTROL SYSTEM
Thomas L. Skillman, Jr. *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 325-336 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29389*# Boeing Computer Support Services, Inc., Huntsville, Ala.
GENERIC SUPERVISOR: A KNOWLEDGE-BASED TOOL FOR CONTROL OF SPACE STATION ON-BOARD SYSTEMS
J. R. Carnes and R. Nelson (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 355-362 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29390*# Vanderbilt Univ., Nashville, Tenn.
PROGRAMMING MODEL FOR DISTRIBUTED INTELLIGENT SYSTEMS
J. Sztipanovits, C. Biegl, G. Karsai, N. Bogunovic, B. Purves, R. Williams, and T. Christiansen (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 363-371 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29394*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.
KNOWLEDGE ACQUISITION AND RAPID PROTYPING OF AN EXPERT SYSTEM: DEALING WITH REAL WORLD PROBLEMS
Patrick A. Bailey and Brett B. Doehr *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 395-402 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29396*# Space Telescope Science Inst., Baltimore, Md.
AUTOMATED GENERATION OF SPACECRAFT ACTIVITY PLANS
Donald A. Rosenthal *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 413-417 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29397*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
INTELLIGENT INTERFACES FOR EXPERT SYSTEMS
James A. Villarreal and Lui Wang *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 419-426 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29399*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
BENCHMARKING EXPERT SYSTEM TOOLS
Gary Riley *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 435-441 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29400*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TWO IMPLEMENTATIONS OF THE EXPERT SYSTEM FOR THE FLIGHT ANALYSIS SYSTEM (ESFAS) PROJECT
Lui Wang *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 443-447 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29401*# Alabama Univ., Huntsville.
LIFE-SPAN KNOWLEDGE ENGINEERING FOR SPACE OPERATIONS
Dan Hays *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 449-456 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29403*# Computer Sciences Corp., Huntsville, Ala.
NOA: A NETWORK OPERATOR ASSISTANT FOR SCHEDULING TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS)
Terry Janssen, Richard A. Berg, and Bikas K. Das *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 465-473 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29405*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.
INTELLIGENT INTERFACE DESIGN AND EVALUATION
Frank L. Greitzer *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 489-496 Sponsored in part by Martin Marietta Denver Aerospace Independent Research and Development (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29406*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE EMERGENCE OF MULTI-USER EXPERT SYSTEMS
Michael S. Freeman *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 497-501 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29407*# Boeing Aerospace Co., Huntsville, Ala. Space Station.
A ROBOTIC SYSTEM FOR AUTOMATION OF LOGISTICS FUNCTIONS ON THE SPACE STATION
J. C. Martin, R. B. Purves, R. N. Hosier, and B. A. Krein (Westinghouse Mfg. Systems and Technology Center, Columbia, Md.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 503-511 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29412*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
UTILIZATION OF ARTIFICIAL INTELLIGENCE TECHNIQUES FOR THE SPACE STATION POWER SYSTEM
Thomas C. Evatt and Edward W. Gholdston *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 555-562 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29413*# Mitre Corp., Houston, Tex.
A METHODOLOGY FOR MULTIPLE RULE SYSTEM INTEGRATION AND RESOLUTION WITHIN A SINGULAR KNOWLEDGE BASE
Frank N. Kautzmann, III *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 563-581 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29414*# Martin Marietta Aerospace, Denver, Colo.
BLACKBOARD ARCHITECTURES AND THEIR RELATIONSHIP TO AUTONOMOUS SPACE SYSTEMS
Allison Thornbrugh *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 583-589 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29415*# Martin Marietta Aerospace, Denver, Colo.
DESIGN CONSIDERATION IN CONSTRUCTING HIGH PERFORMANCE EMBEDDED KNOWLEDGE-BASED SYSTEMS (KBS)
Shelly D. Dalton and Philip C. Daley *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 591-596 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29416*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Software Technology Center.
VALIDATION OF EXPERT SYSTEMS
Rolf A. Stachowitz and Jacqueline B. Combs *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 597-606 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29424*# Digital Equipment Corp., Atlanta, Ga.
AI TOOLS IN COMPUTER BASED PROBLEM SOLVING Abstract Only
Arthur J. Beane *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 621 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

N88-29425*# Gold Hill Computers, Inc., Cambridge, Mass.
NETWORKING AND AI SYSTEMS: REQUIREMENTS AND BENEFITS Abstract Only
In NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 623-624 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-29450# Purdue Univ., West Lafayette, Ind. Dept. of Statistics.
SELECTING THE BEST BINOMIAL POPULATION: PARAMETRIC EMPIRICAL BAYES APPROACH
Shanti S. Gupta and TaChen Liang 1 Feb. 1988 21 p
(Contracts N00014-84-C-0167; N00014-88-K-0170)
(AD-A193341; TR-88-1) Avail: NTIS HC A03/MF A01 CSCL 12C

Consider k populations pi(1),...,pi(k), where an observation from population pi(i) has a binomial distribution with parameters N and p(sub i) (unknown). Let p(k) = max over 1 less than or equal to j less than or equal to k p(sub j). A population pi(i) with p(sub i)= p(k) is called a best population. We are interested in selecting the best population. Let p = (p(sub 1),.., p(sub k)) and let a denote the index of the selected population. Under the loss function L(p, a) = p (k) - p(sub a), this statistical selection problem is studied via a parametric empirical Bayes approach. It is assumed that the binomial parameters p(sub i), i = 1,...,k, follow some conjugate beta prior distributions with unknown hyperparameters. Under the binomial-beta statistical framework, an empirical Bayes selection rule is proposed. It is shown that the Bayes risk of the proposed empirical Bayes selection rule converges to the corresponding minimum Bayes risk with rates of convergence at least of order O(exp(-cn)) for some positive constant c, where n is the number of accumulated past experience (observations) at hand. GRA

N88-29451# Wisconsin Univ., Madison. Center for Mathematical Sciences.
ON A CLASS OF FUNCTIONALS INVARIANT UNDER A Z(SUP n) ACTION Technical Summary Report
Paul H. Rabinowitz Aug. 1987 18 p
(Contract DAAL03-87-K-0043; Grant AF-AFOSR-0202-87)
(AD-A193474; CMS-TSR-88-1) Avail: NTIS HC A03/MF A01 CSCL 12A

This document considers a system of ordinary differential equations of the form (*) q + V sub q (t,q) = f(t) where f and V are periodic in t, V is periodic in the components of q = (q sub 1,..., q sub m), and the mean value of f vanishes. By showing that a corresponding functional is invariant under a natural Z sub n action, a simple variational argument yields at least n + 1 distinct periodic solutions of (*). More general versions of (*) are also treated as is a class of Neumann problems for semilinear elliptic partial differential equations. GRA

N88-29452# Wisconsin Univ., Madison. Center for Mathematical Sciences.
THE CONSTRUCTION OF IMPLICIT AND EXPLICIT SOLITARY WAVE SOLUTIONS OF NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS Technical Summary Report
Willy Hereman Aug. 1987 23 p
(Grant AF-AFOSR-0263-85)
(AD-A193475; CMS-TSR-88-2) Avail: NTIS HC A03/MF A01 CSCL 12A

By means of easy examples, such as the Korteweg-de Vries, the Harry Dym, the sine-Gordon equations, and the Hirota coupled system, it is shown how nonlinear partial differential equations can be exactly solved by a direct algebraic method. The physical concept, on which the method relies, is one of generation and mixing of the real exponential solutions of the underlying linear equations. This approach leads in a straightforward way to single solitary waves of pulse, kink and cusp shape. The extension of the method towards the construction of multi-soliton solutions and the connections with other direct methods are outlined. GRA

N88-29453# Wisconsin Univ., Madison. Center for Mathematical Sciences.
A MINIMAX METHOD FOR A CLASS OF HAMILTONIAN SYSTEMS WITH SINGULAR POTENTIALS Technical Summary Report
Abbas Bahri and Paul H. Rabinowitz Oct. 1987 23 p
(Contract DAAL03-87-K-0043; Grant AF-AFOSR-0202-87)
(AD-A193478; CMS-TSR-88-8) Avail: NTIS HC A03/MF A01 CSCL 12B

This paper presents a minimax method which gives existence and multiplicity results for time periodic solutions of a class of Hamiltonian systems when a singular potential is present. The singularity satisfies the strong force condition of Gordon. When milder singularities are permitted a notion of generalized T-periodic solution is introduced and we get existence and multiplicity results for such solutions. GRA

N88-29454# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
ON THE DISTRIBUTION EQUATIONS
F. M. deOliveiraCastro 1987 10 p In FRENCH
(DE88-702217; CBPF-NF-050/87) Avail: NTIS (US Sales Only) HC A02/MF A01

A fundamental problem of variational calculus is generalized and its correspondent Euler equation is obtained from generalized distribution equations. DOE

N88-29455*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STABILITY OF SEMIDISCRETE APPROXIMATIONS FOR HYPERBOLIC INITIAL-BOUNDARY-VALUE PROBLEMS: STATIONARY MODES
Robert F. Warming and Richard M. Beam Jul. 1988 18 p
(NASA-TM-100994; A-88165; NAS 1.15:100994) Avail: NTIS HC A03/MF A01 CSCL 12A

Spatially discrete difference approximations for hyperbolic initial-boundary-value problems (IBVPs) require numerical boundary conditions in addition to the analytical boundary conditions specified for the differential equations. Improper treatment of a numerical boundary condition can cause instability of the discrete IBVP even though the approximation is stable for the pure initial-value or Cauchy problem. In the discrete IBVP stability literature there exists a small class of discrete approximations called borderline cases. For nondissipative approximations, borderline cases are unstable according to the theory of the Gustafsson, Kreiss, and Sundstrom (GKS) but they may be Lax-Richtmyer stable or unstable in the L sub 2 norm on a finite domain. It is shown that borderline approximation can be characterized by the presence of a stationary mode for the finite-domain problem. A stationary mode has the property that it does not decay with time and a nontrivial stationary mode leads to algebraic growth of the solution norm with mesh refinement. An analytical condition is given which makes it easy to detect a stationary mode; several examples of numerical boundary conditions are investigated corresponding to borderline cases. Author

N88-29456# North Carolina Univ., Chapel Hill. Dept. of Statistics.
WEAK SOLUTION OF THE LANGEVIN EQUATION ON A GENERALIZED FUNCTIONAL SPACE
Itaru Mitoma Feb. 1988 46 p
(Contract F49620-85-C-0144)
(AD-A194290; TR-222; AFOSR-88-0351TR) Avail: NTIS HC A03/MF A01 CSCL 12C

The contents of this report on the Langevin equation is as follows: (1) Introduction; (2) Existence and Uniqueness for Solutions of the Langevin Equations; (3) Proof of Lamma 1; (4) Generation of the Kolmogorov Evolution Operator; and (5) Central Limit Theorem for a Lattice System of Interacting Diffusions. GRA

N88-29457# Wisconsin Univ., Madison. Center for Mathematical Sciences.
PERIODIC SOLUTIONS OF PERTURBED SUPERQUADRATIC HAMILTONIAN SYSTEMS Technical Summary Report
Yiming Long Dec. 1987 51 p
(Contracts DAAL03-87-K-0043; N00014-88-K-0134)
(AD-A194292; CMS-TSR-88-23) Avail: NTIS HC A04/MF A01 CSCL 12B

This paper proves the existence of infinitely many distinct T-periodic solutions of a certain perturbed Hamiltonian system under the conditions that H is of C(sub 1), superquadratic, and possesses exponential or polynomial growth at infinity and that f is of sub 1, 2 and T-periodic, via minimax methods. GRA

N88-29458# Wisconsin Univ., Madison. Center for Mathematical Sciences.
MACSYMA PROGRAM FOR THE PAINLEVE TEST OF NONLINEAR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS Technical Summary Report
Willy Hereman and Eric VanDenBulck Dec. 1987 16 p
(Grant AF-AFOSR-0263-85)
(AD-A194293; CMS-TSR-88-21) Avail: NTIS HC A03/MF A01 CSCL 12D

MACSYMA program is presented which determines whether a given single nonlinear ODE or PDE with real polynomial terms fulfills the necessary conditions for having the Painleve property. The program listing is given, together with a synopsis of the algorithm, a model of the output of the program, a list of tested examples and instructions to use the package. GRA

N88-29459# Wisconsin Univ., Madison. Center for Mathematical Sciences.
ON THE PERIODIC NONLINEARITY AND THE MULTIPLICITY OF SOLUTIONS Technical Summary Report
Kung-Ching Chang Nov. 1987 18 p
(Contract DAAL03-87-K-0036)
(AD-A194295; CMS-TSR-88-19) Avail: NTIS HC A03/MF A01 CSCL 12B

This document studies the multiplicity of solutions for semilinear elliptic systems as well as Hamiltonian systems, in which the nonlinear terms are periodic in certain variables. The cuplength for cohomology rings of the torus is used. The results generalize and unify several recent works by Conley-Zehnder, Rabinowitz, Mawhin-Willem, Pucci-Serrin etc. In particular, the resonance problems and indefinite problems are studied. GRA

N88-29460# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
AN ASYMPTOTIC EVALUATION OF THE TAIL OF A MULTIPLE SYMMETRIC ALPHA-STABLE INTEGRAL
Gennady Samorodnitsky and Jerzy Szulga Feb. 1988 28 p
(Contract F49620-85-C-0144)
(AD-A194570; TR-226; AFOSR-88-0419TR) Avail: NTIS HC A03/MF A01 CSCL 12C

A multiple symmetric alpha stable integral multiple sums over f(t sub1,...,t sub n) dM(t sub 1)...dM(t sub n) into a Le Page type multiple series of transformed arrival times of a Poisson process are expanded. An exact evaluation of the limit of appropriately normalized tail distribution results from this representation. GRA

N88-29461# Nebraska Univ., Lincoln. Dept. of Mathematics and Statistics.
CANONICAL FORMS IN THE CONTROL OF DPS Final Report, 1 Apr. 1986 - 31 Mar. 1988
Richard Rebarber 8 Apr. 1988 3 p
(Grant AF-AFOSR-0079-86)
(AD-A194671; AFOSR-88-0439TR) Avail: NTIS HC A02/MF A01 CSCL 12I

Control canonical forms play an important role in the analysis of finite-dimensional problems in control theory. The goal of this research was to extend these results and develop control canonical forms for infinite-dimensional systems. These results were derived for a broad class of problems, including some with unbounded

input (as occurs with boundary control problems). This analysis led to approximate feedback control methods (i.e., using finite-dimensional controls) by truncating the resulting series which solves the eigenvalue specification problem. Results were published in a series of five papers, including Canonical forms for a class of distributed parameter control systems, Spectral assignability for disturbed parameter systems with unbounded scalar control, and Spectral determination for a cantilevel beam. GRA

N88-29462# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
APPROXIMATIONS AND IMPLEMENTATIONS OF NONLINEAR FILTERING SCHEMES Final Technical Report, 11 Aug. 1984 - 30 Sep. 1987
A. H. Haddad and E. I. Verriest Feb. 1988 333 p
(Contract F08635-84-C-0273)
(AD-A194685; AD-E801635; AFATL-TR-87-73) Avail: NTIS HC A15/MF A01 CSCL 12C

The objective of this program is to develop approximation models that may be used for the implementation of nonlinear filtering schemes. The approach is based on two major concepts. The first is concerned with the approximation of nonlinear models for air-to-air missile scenarios by a Markov linear approximate model. The second concept is concerned with models for the errors due to the finite word-length implementation of the filters. In addition, the project is involved with the study of hybrid system models that result when nonlinear or linear models such as these are quantized and are subject to switches among a set of linear models. The switching can either be deterministic or stochastic and may involve fast and slow dynamics. GRA

N88-29463# Army Armament Research and Development Command, Watervliet, N. Y.
A TECHNIQUE FOR MEASURING AREA UNDER A CURVE Final Report
J. H. Underwood Mar. 1988 12 p
(AD-A193559; ARCCB-MR-88014) Avail: NTIS HC A03/MF A01 CSCL 12A

Measurement of the area under a curve is often the most direct way to determine the energy of a mechanical system. Area measurements are now routinely used in fracture mechanics testing as part of the standard test method for the J-integral fracture toughness. Vossoughi recently described a method for measuring the area under a curve, based on the weight of a template of the area. The technique suggested here is a simple geometric procedure suited to the relatively regular shapes of elastic-plastic load versus displacement plots of the type shown by curve OAB in Figure 1. This curve is typical of those obtained from tensile strength and fracture toughness tests of metals. GRA

N88-29464# Army Armament Research and Development Command, Watervliet, N. Y.
AN ADAPTIVE OVERLAPPING LOCAL GRID REFINEMENT METHOD FOR TWO-DIMENSIONAL PARABOLIC SYSTEMS Final Report
Peter K. Moore and Joseph E. Flaherty Feb. 1988 30 p
(AD-A193560; ARCCB-TR-88010) Avail: NTIS HC A03/MF A01 CSCL 12A

An adaptive local refinement element method is described for solving vector systems of parabolic partial differential equations in two-space dimensions and time. The algorithm uses the finite element Galerkin method in space and backward Euler temporal integration. Each time step obtains an estimate of the error on each element, groups the elements whose error violates a user prescribed tolerance, forms new local grids, and solves the problem again on each of the new grids. Discussed are several aspects of the algorithm including the necessary data structures, the error estimation technique, and the determination of initial and boundary conditions at coarse-fine mesh interfaces. Finally, several examples demonstrate the viability of this approach. GRA

N88-29465# Washington State Univ., Pullman.
INVESTIGATION OF THE HIGHER-ORDER ELEMENTS IN THE SAMSON2 CODE Final Report, Apr. 1985 - Jul. 1986
Steven S. Miller and Harold C. Sorensen Apr. 1988 205 p
(Contract F29601-85-K-0050)
(AD-A193638; AFWL-TR-86-85) Avail: NTIS HC A10/MF A01 CSCL 12A

The objective of this research effort was to determine whether the current finite element formulation in the SAMSON2 code for the eight-node quadrilateral higher-order isoparametric continuum element produces consistent and reliable results. Some effort was also performed toward investigating the finite element formulations for the five-node and the six-node triangular isoparametric continuum elements. Four tasks were executed in this research effort. The first task was a study of some of the previous work performed. The second task involved comparisons between program results and analytical solutions for various problems. The third task was the verification and correction where necessary of the finite element formulation for the eight-node quadrilateral continuum element. The fourth task was a study of the effects on the problem results which were caused by the corrected finite element formulation. GRA

N88-29466# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
PRACTICAL HIGHER-ORDER FUNCTIONAL AND LOGIC PROGRAMMING BASED ON LAMBDA-CALCULUS AND SET-ABSTRACTION
Frank S. Silbermann and Bharat Jayaraman Jan. 1988 12 p
(Contract N00014-86-K-0680; Grant NSF DCR-86-03609)
(AD-A193645; TR88-004) Avail: NTIS HC A03/MF A01 CSCL 12E

A new variation of relative set abstraction is proposed as an extension to a lambda-calculus based functional language. This feature interacts orthogonally with the standard functional language capabilities, yet provides the full expressive power of first-order Horn-logic programming, as well as a very useful subset of higher-order Horn-logic programming. This resulting language lends itself to efficient interpretation, in that complete operational procedures are possible without computationally expensive primitives such as higher-order unification, unification relative to an equational theory, or general theorem-proving. GRA

N88-29467# Ballistic Research Labs., Aberdeen Proving Ground, Md.
POLYNOMIAL DEFINITION OF DISCRETE FIELD POINTS OF MAP OF DIFFUSION EQUATION, PART 1
William F. Donovan Mar. 1988 40 p
(AD-A193697; BRL-MR-3649-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 12A

The diffusion equation of Physics has been used to analyze unsteady heat transfer, boundary layer velocity distribution, long line electrical voltage fluctuation, and salt-solute penetration. There are two approaches to the problem statement and solution; the one most widely used being transformation, and the other, finite difference techniques, employ variations of summing averages of term values established by unique methods. This report considers an averaging type solution in algebraic format. The final result consists of a series of discrete polynomials with rational coefficients which describe the dependent variable at each time-distance coordinate in the manner of the non-reflecting Schmidt plot. Essentially, the differential equation is recast as a finite difference expression which is transposed first to geometric and then to polynomial algebraic form. The polynomials, representing discrete solutions to the differential equations, are analyzed by differencing techniques whereby the numerical coefficients of common diagonal terms are found to be expressible in a generalized matrix. GRA

N88-29468# Princeton Univ., N. J. Dept. of Computer Science.
FINDING MINIMUM-COST CIRCULATIONS BY CANCELING NEGATIVE CYCLES
Andrew V. Goldberg and Robert E. Tarjan Jul. 1987 20 p

(Contracts N00014-80-C-0622; N00014-87-K-0467)
(AD-A194027; CS-TR-107-87) Avail: NTIS HC A03/MF A01 CSCL 12D

A classical algorithm for finding a minimum-cost circulation consists of repeatedly finding a residual cycle of negative cost and canceling it by pushing enough flow around the cycle to saturate an arc. We show that a judicious choice of cycles for canceling leads to a polynomial bound on the number of iterations in this algorithm. This gives a very simple strongly polynomial algorithm that uses no scaling. A variant of the algorithm that uses dynamic trees runs in O(nm(log n) min log (nC), m log n) time on a network of n vertices, m arcs, and arc costs of maximum absolute value C. This bound is comparable to those of the fastest previously known algorithms. GRA

N88-29469# Princeton Univ., N. J. Dept. of Computer Science.
FINDING MINIMUM-COST CIRCULATIONS BY SUCCESSIVE APPROXIMATION
Andrew V. Goldberg and Robert E. Tarjan Jul. 1987 56 p
(Contracts N00014-80-C-0622; N00019-87-K-0467)
(AD-A194028; CS-TR-106-87) Avail: NTIS HC A04/MF A01 CSCL 12D

A new approach to solving minimum-cost circulation problems is developed. This approach combines methods for solving the maximum flow problem with successive approximation techniques based on cost scaling. The authors measure the accuracy of a solution by the amount that the complementary slackness conditions are violated. They propose a simple minimum-cost circulation algorithm, one version of which runs in O(cu n log(nC)) time on an n-vertex network with integer arc costs of absolute value at most C. By incorporating sophisticated data structures into the algorithm, we obtain a time bound of O(nm log(sq n/m) log(nC)) on a network with m arcs. A slightly different use of our approach shows that a minimum-cost circulation can be computed by solving a sequence of O(n log(nC)) blocking slow problems. A corollary of this result is an O(sq n (log n) log (nC)-time, n-processor parallel minimum cost circulation algorithm. This approach also yields strongly polynomial minimum-cost circulation algorithms. Results provide evidence that the minimum-cost circulation problem is not much harder than the maximum flow problem. It is believed that a suitable implementation of this method will perform extremely well in practice. GRA

N88-29470# Princeton Univ., N. J. Dept. of Computer Science.
RELAXED HEAPS: AN ALTERNATIVE TO FIBONACCI HEAPS
James R. Driscoll, Harold N. Gabow, Ruth Shrairman, and Robert E. Tarjan Jul. 1987 17 p
(Contract N00014-87-K-0467; Grant NSF MCS-83-02648)
(AD-A194030; CS-TR-109-87) Avail: NTIS HC A03/MF A01 CSCL 12D

The relaxed heap is a priority queue data structure that achieves the same amortized time bounds as the Fibonacci heap - a sequence of m decrease key and n delete min operations takes time O(m + n log n). A variant of relaxed heaps achieves similar bounds in the worst case- o(1) time for decrease key and O(log n) for delete min. A relaxed heap is a type of binomial queue that allows heap order to be violated. GRA

N88-29471# Princeton Univ., N. J. Dept. of Computer Science.
IMPROVED TIME BOUNDS FOR THE MAXIMUM FLOW PROBLEM
Ravindra K. Ahuma, James B. Orlin, and Robert E. Tarjan Sep. 1987 22 p
(Contract N00014-87-K-0467; Grant NSF DCR-86-05962)
(AD-A194034; CS-TR-118-87) Avail: NTIS HC A03/MF A01 CSCL 12D

A new approach is proposed to the maximum network flow problem. The approach yields a very simple algorithm running O(n-cubed) time on n-vertex networks. Incorporation of the dynamic tree data structure of Sleator and Tarjan yields a more complicated algorithm with a running time of O(nm log (n-squared/m)) on m-edge networks. A variant of the algorithm is developed that uses scaling and runs in O(nm + (n-sq) log U) time on networks with integer edge capacities bounded by U. This paper obtains a modification of the Ahuja-Orlin algorithm with a running time of O(nm + (n-sq) (log U)/(log log U). The use of dynamic trees in this algorithm further reduces the time bound on O(nm log (n log U/m log log U + 2)). This result demonstrates that the combined use of scaling and dynamic trees results in speed not obtained by using either technique alone. GRA

N88-29472# International Centre for Theoretical Physics, Trieste (Italy).
CRITICAL VALUES OF FUNCTIONALS ON BANACH SURFACES
Minh Duc Duong Nov. 1987 22 p
(DE88-702735; IC-87/344) Avail: NTIS (US Sales Only) HC A03/MF A01

In this paper we define the directional differentiability along a dense linear subspace D of a Banach space E and study the critical values of D-differentiable functionals on surfaces in E. DOE

N88-29473# Sao Paulo Univ. (Brazil). Inst. de Fisica.
BIFURCATIONS OF PERIODIC SOLUTIONS OF NON-INTEGRABLE HAMILTONIANS WITH TWO DEGREES OF FREEDOM: NUMERICAL AND ANALYTICAL RESULTS
M. A. M. deAguiar, C. P. Malta, M. Baranger, and K. T. R. Davies Apr. 1987 79 p
(DE88-702747; IFUSP-P-636) Avail: NTIS HC A05/MF A01

An analytical study of the bifurcations of periodic solutions observed numerically in a two-dimensional non-integrable Hamiltonian system with two degrees of freedom is presented. DOE

N88-29474# Leiden Univ. (Netherlands).
STABILITY AND CONVERGENCE IN THE NUMERICAL SOLUTION OF STIFF INITIAL VALUE PROBLEMS Ph.D. Thesis
Johannes Franciscus Kraaijevanger 1986 121 p
(B8681480; ETN-88-92896) Avail: NTIS HC A06/MF A01

Stepsize restrictions for stability in the numerical solution of ordinary and partial differential equations; absolute monotonicity of polynomials occurring in the numerical solution of initial value problems; absolute monotonicity of rational functions occurring in the numerical solution of initial value problems; algebraic stability and error propagation in Runge-Kutta methods; B-convergence of the implicit midpoint rule and the prapezoidal rule; and the order of B-convergence of the Gaussian Runge-Kutta methods are discussed. ESA

N88-29475# Admiralty Research Establishment, Teddington (England).
SOLUTION OF LARGE ORDER FOURIER-BESSEL EQUATIONS
S. J. Roberts Dec. 1987 16 p
(ARE-TM(UHA)-88504; BR105867; ETN-88-92832) Copyright Avail: NTIS HC A03/MF A01

Large order Fourier-Bessel equations, whose derivative is zero at the boundaries of a cylindrical geometry, are solved using a series expansion method. ESA

N88-29476# Loughborough Univ. of Technology (England). Dept. of Mathematics.
GENERATING SEMI-GAUSSIAN TWO DIMENSIONAL QUADRATURE RULES
V. U. Aihie and G. A. Evans Dec. 1987 13 p
(Rept-205; ETN-88-92833) Avail: NTIS HC A03/MF A01

A procedure to generate two-dimensional quadrature rules is described. The total number m of equations, n (n less than m) of the unknowns appear linearly with coefficients which may be nonlinear combinations of the other variables. Hence the set of (m - n) nonlinear equations can be solved by a Newton algorithm which is efficient as the nature of the problem yields good first estimates. The current iterates of the nonlinear variables are used to compute the coefficients of the linear variables. These can then be solved by conventional elimination, to be substituted into the (m - n) nonlinear equations in the Newton algorithm to generate

the next set of iterates. Estimated partial derivatives are used based on a first order finite difference form. By this means the number of expensive to solve nonlinear equations is kept to a minimum, especially given that long arithmetic is used to counter ill-conditioning in the defining equations. ESA

N88-29477# Leiden Univ. (Netherlands). Inst. of Mathematics.
NONLINEAR ELLIPTIC PROBLEMS WITH CRITICAL EXPONENT IN SHRINKING ANNULI
C. Bandle (Basel Univ., Switzerland) and L. A. Peletier Jan. 1987 30 p
(W-87-02; ETN-88-92907) Avail: NTIS HC A03/MF A01

For R sup N, with N less than 2, and the annulus A = the set (X : rho less than (x) less than R) with rho between D and R, two types of nonlinear boundary value problems are considered. The behavior of the solutions as the inner boundary shrinks to a point is analyzed. ESA

N88-29478# Leiden Univ. (Netherlands). Inst. of Mathematics.
ELLIPTIC EQUATIONS WITH NEARLY CRITICAL GROWTH
L. A. Peletier, F. V. Atkinson, and C. Bandle Jan. 1987 15 p
(W-87-16; ETN-88-92908) Avail: NTIS HC A03/MF A01

The problem (- delta u = f (u), u less than 0 in omega, over u = 0 on delta omega is treated. Omega is a bounded domain in R sup N, with smooth boundary delta omega, and f is a smooth function with the properties f (0) = 0, f (u) less than 0 if u less than 0. Existence and uniqueness of solutions with reference to the growth of the function f (u) as u tends to infinity are discussed. ESA

N88-29479# Loughborough Univ. of Technology (England). Dept. of Mathematics.
ON MATRIX PENCIL EQUIVALENTS OF A GENERAL POLYNOMIAL MATRIX
G. E. Hayton, A. B. Walker (Hull Univ., England), and A. C. Pugh May 1988 14 p
(Math-Rept-207; ETN-88-93143) Avail: NTIS HC A03/MF A01

An algorithm which permits the reduction of a general polynomial matrix to an equivalent matrix pencil form is described. The sense in which this is an equivalent is shown both from a matrix transformational point of view, and from the point of view of the properties which the given matrix and the associated pencil share. In the case of the former, it is seen that the reduction to matrix pencil form is accomplished by the matrix transformation, termed full equivalence. Thus despite its rather untidy specification, this relation does possess very interesting properties, e.g., it leaves invariant the finite and infinite zero structure of the transformed matrix (Hayton, Pugh, and Fretwell, 1988). It is this feature which provides the second interpretation of the way in which the associated matrix pencil is equivalent to the original polynomial matrix. ESA

N88-29480*# Akron Univ., Ohio. Dept. of Mechanical and Polymer Engineering.
FINITE ELEMENT ANALYSIS OF STEADY AND TRANSIENTLY MOVING/ROLLING NONLINEAR VISCOELASTIC STRUCTURE. PART 1: THEORY Biannual Report, Feb. 1986
Joe Padovan Feb. 1986 160 p
(Grant NAG1-444)
(NASA-CR-179886; NAS 1.26:179886) Avail: NTIS HC A08/MF A01 CSCL 12A

In a three part series of papers, a generalized finite element analysis scheme is developed to handle the steady and transient response of moving/rolling nonlinear viscoelastic structure. This paper considers the development of the moving/rolling element strategy, including the effects of large deformation kinematics and viscoelasticity modelled by fractional integro-differential operators. To improve the solution strategy, a special hierarchical constraint procedure is developed for the case of steady rolling/translating as well as a transient scheme involving the use of a Grunwaldian representation of the fractional operator. In the second and third parts of the paper, 3-D extensions are developed along with transient contact strategies enabling the handling of impacts with obstructions. Overall, the various developments are benchmarked via comprehensive 2- and 3-D simulations. These are correlated with experimental data to define modelling capabilities. Author

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-29481*# Hampton Inst., Va. Dept. of Mathematics.
ON WIENER-MASANI'S ALGORITHM FOR FINDING THE GENERATING FUNCTION OF MULTIVARIATE STOCHASTIC PROCESSES
A. G. Miamee [1988] 8 p
(Grant NAG1-768)
(NASA-CR-182905; NAS 1.26:182905) Avail: NTIS HC A02/MF A01 CSCL 12A

It is shown that the algorithms for determining the generating function and prediction error matrix of multivariate stationary stochastic processes developed by Wiener and Masani (1957), and later by Masani (1960) will work in some more general setting. Author

N88-29482# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
ON STABLE MARKOV PROCESSES Technical Report No. 203, Sep. 1987 - Aug. 1988
Robert J. Adler, Stamatis Gambanis, and Gennady Samorodnitsky Sep. 1987 46 p
(Contract F49620-85-C-0144)
(AD-A192892; AFOSR-88-0359TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Necessary conditions are given for a symmetric alpha-stable (SaS) process, 1 less then alpha less than 2, to be Markov. These conditions are then applied to find Markov or weakly Markov processes within certain important classes of S alpha S processes: time changed Levy motion, sub-Gaussian processes, moving averages and harmonizable processes. Two stationary S alpha S Markov processes are introduced, the right and the left S alpha S Ornstein-Uhlenbeck processes. Some of the results are in sharp contrast to the Gaussian case alpha = 2. GRA

N88-29483# Illinois Univ., Urbana. Psychometric Group.
A NONPARAMETRIC MULTIDIMENSIONAL IRT APPROACH WITH APPLICATIONS TO ABILITY ESTIMATION AND TEST BIAS
William Stout Apr. 1988 55 p
(Contract N00014-87-K-0277; Proj. RR0-4204)
(AD-A194212; Rept-88-1-ONR) Avail: NTIS HC A04/MF A01 CSCL 12C

A determined case is made for the use of a nonparametric multidimensional monotonic IRT modeling framework with local independence replaced by the less restrictive assumption of essential independence. The concept of essential dimensionality is then introduced to count the number of dominant latent dimensions. Consequences of this more general approach include the consistent estimation of ability on a common scale using a natural class of estimators, uniqueness of the latent ability when essential unidimensionality holds, a theoretical treatment of test bias, an IRT based notion of validity, and a reassessment of the importance of the concept of item parameter invariance. GRA

N88-29484# Purdue Univ., West Lafayette, Ind. Dept. of Statistics.
COMMENTARY ON HAROLD HOTELLING'S ARTICLES ON THE TEACHING OF STATISTICS
Shanti S. Gupta Apr. 1988 8 p
(Contract N00014-88-K-0170)
(AD-A194215; TR-88-12) Avail: NTIS HC A02/MF A01 CSCL 12C

It is close to half a century since the first of these two papers

by Hotelling was published. The second paper, published nearly a decade after publication of the first, reexamines the issues raised in the first and amplifies on the organizational and teaching personnel issues. For one who reads (or rereads) these papers, the striking fact is the thoroughness with which Hotelling has analyzed the many issues that could and would arise in the teaching of statistics. In 1940, statistics was not yet thought of as an independent discipline of study. The subject was still very young. There were only a handful of pioneers - Hotelling one among them - doing research that can be classified as theoretical or mathematical statistics as we know it today. Many of the personalities that would come later and leave their impact on the history and development of the subject were not yet to embark or had hardly embarked upon their careers in statistics. It is in this context that Hotelling's discussion and analysis of the issues involved in the teaching of statistics stand out so distinctively for the foresight and clarity exhibited. In analyzing the problems associated with teaching of statistics in universities, Hotelling has viewed the topic as consisting of three inseparably connected issues: teaching, research, and consulting. Many of the problems discussed here are typically still with us, some have been resolved the way he foresaw or recommended, and some would come back in different contexts as the subject itself were to grow.

GRA

N88-29485# Wisconsin Univ., Madison. Center for Mathematical Sciences.

EXACT LOWER CONFIDENCE LIMITS FOR THE RELIABILITY OF k OF n SYSTEMS FOR ZERO FAILURES AND NONCONSERVATIVENESS OF THE MAXIMUS METHOD

Technical Summary Report

Andrew P. Soms Jan. 1988 7 p

(AD-A194299; CMS-TSR-88-24) Avail: NTIS HC A02/MF A01 CSCL 12E

The Buehler (1957) optimal 1-alpha lower confidence limits on the reliability of k of n systems of independent components is derived for the case of zero failures and equal sample sizes. The limiting form of the lower confidence limit is obtained for n-1 of n systems as n goes to infinity. This result is used to show the nonconservativeness of the maximus method given by Spencer and Easterling (1986). GRA

N88-29486# Naval Postgraduate School, Monterey, Calif.

DIGITAL FILTER DESIGN TECHNIQUES M.S. Thesis

Janine V. England Mar. 1988 181 p

(AD-A194484) Avail: NTIS HC A09/MF A01 CSCL 12E

An overview and investigation of the more popular digital filter design techniques are presented, with the intent of providing the filter design engineer a complete and concise source of information. Advantages and disadvantages of the various techniques are discussed, and extensive design examples used to illustrate their application to specific design problems. Both IIR (Butterworth, Chebyshev and elliptic), and FIR (Fourier coefficient design, windows and frequency sampling) design methods are featured, as well as the Optimum FIR Filter Design Program of Parks and McClellan, and the Minimum p - Error IIR Filter Design Method of Deczky. GRA

N88-29487# Space Computer Corp., Santa Monica, Calif.

OBJECT DISCRIMINATION VIA BULK TEMPERATURE/VELOCITY FILTERING, PHASE 1 Final Technical Report, 14 Aug. 1987 - 14 Feb. 1988

William B. Kendall 12 Apr. 1988 66 p

(Contract N00014-87-C-0801)

(AD-A194533; SCC-R-102-3) Avail: NTIS HC A04/MF A01 CSCL 12E

Work on the velocity filter approach to target detection and tracking is described, including its application to kinetic kill debris rejection. We present results of theoretical studies deriving the optimum (maximum-likelihood) filter for detecting a target moving through a sequence of N passive sensor image frames with a known, assumed or estimated vector velocity in which the target and background observations are modeled as independent Poisson processes and where both uniform and nonhomogeneous backgrounds are considered. Also presented are the results of algorithm simulation experiments conducted with (1) digital imagery recorded by the 30-inch Quad-Camera optical telescope, and (2) simulated target imagery. Finally, a study of alternative approaches to processor implementation is presented. The implementation study includes consideration of a fine-grained, massively-parallel associative processor. GRA

N88-29488# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.

LIMITING DISTRIBUTIONS OF NON-LINEAR VECTOR FUNCTIONS OF STATIONARY GAUSSIAN PROCESSES

Technical Report No. 228, Sep. 1987 - Aug. 1988

Hwai-Chung Ho and Tze-Chien Sun Mar. 1988 21 p Prepared in cooperation with Wayne State Univ., Detroit, Mich.

(Contract F49620-85-C-0144)

(AD-A194569; AFOSR-88-0418TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Given a stationary Gaussian vector process x sub m, ym an element of Z, and two real functions H(x) and K(x) we define Z sub H superscript N define Sum from m=1 to (n-1) of Inverse A sub n Sum from m=1 to (n-1) of Sub m and Sub K superscript k Inverse B Sub n Sum from m=1 to (n-1) of Sub n where An and Bn are some appropriate constants. The joint limiting distribution of Sub H superscript n Sub k superscript k is investigated. It is shown that Sub H superscript n and Sub k superscript k are asymptotically independent when one of them satisfies a central limit theorem. The application of this to the limiting distribution for a certain class of non-linear infinite-coordinated functions of a Gaussian process is also discussed. GRA

N88-29489*# George Washington Univ., Hampton, Va.

TWO BIASED ESTIMATION TECHNIQUES IN LINEAR REGRESSION: APPLICATION TO AIRCRAFT

Vladislav Klein Jul. 1988 41 p

(NASA-TM-100649; NAS 1.15:100649) Avail: NTIS HC A03/MF A01 CSCL 12A

Several ways for detection and assessment of collinearity in measured data are discussed. Because data collinearity usually results in poor least squares estimates, two estimation techniques which can limit a damaging effect of collinearity are presented. These two techniques, the principal components regression and mixed estimation, belong to a class of biased estimation techniques. Detection and assessment of data collinearity and the two biased estimation techniques are demonstrated in two examples using flight test data from longitudinal maneuvers of an experimental aircraft. The eigensystem analysis and parameter variance decomposition appeared to be a promising tool for collinearity evaluation. The biased estimators had far better accuracy than the results from the ordinary least squares technique. Author

N88-29490# Pittsburgh Univ., Pa. Center for Multivariate Analysis.

STRONG LAW FOR MIXING SEQUENCE

Xiru Chen and Yuehua Wu Dec. 1987 15 p

(Contract F49620-85-C-0008)

(AD-A193615; TR-84-47; AFOSR-88-0401TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Presented are some theorems on the strong law for the mixing sequence which is not necessarily stationary, and the mixing coefficient involving only a pair of variables in the sequence.

GRA

N88-29491# South Carolina Univ., Columbia. Center for Machine Intelligence.

EASY BAYES ESTIMATION FOR RASCH-TYPE MODELS

Technical Report, 15 Aug. 1986 - 30 Nov. 1987

Robert J. Jannarone, James E. Laughlin, and Kai F. Yu 4 Nov. 1987 15 p

(Contract N00014-86-K-0817; Proj. RR0-4204)

(AD-A193628; USCMI-87-66) Avail: NTIS HC A03/MF A01 CSCL 12C

A Bayes estimation procedure is introduced that allows the nature and strength of prior beliefs to be easily specified and posterior models to be estimated with no more difficulty than maximum likelihood estimation. The procedure is based on constructing posterior distributions that are formally identical to likelihoods, but are constructed partly from sample data and partly from artificial data reflecting prior information. Improvements in performance of modal Bayes procedures relative to maximum likelihood likelihood estimation procedures are illustrated for Rasch-type models. Improvements range from modest to dramatic, depending on the model and the number of items being considered. GRA

N88-29492# Naval Underwater Systems Center, New London, Conn.
WIGNER DISTRIBUTION FUNCTION: RELATION TO SHORT-TERM SPECTRAL ESTIMATION, SMOOTHING AND PERFORMANCE IN NOISE
Albert H. Nuttall 16 Feb. 1988 164 p
(AD-A193865; NUSC-TR-8225) Avail: NTIS HC A08/MF A01 CSCL 12C

The properties and behavior of the Wigner Distribution Function (WDF) are investigated both analytically and by means of a number of simple informative examples. The lack of local temporal averaging when obtaining the instantaneous correlation function, and the lack of weighting the longer delay values when transforming to the instantaneous spectrum, are shown to be the causes of the deleterious interference effects that are inherent to the WDF. The equivalence of short-term spectral estimation to the smoothed WDF offers an attractive alternative with guaranteed positive distribution values and no interference effects. The performance of a processor which estimates the WDF of a signal waveform in the presence of additive noise is investigated in terms of the output mean, bias, and variance. Dependence on filtering the input and time-weighting is allowed and included in the analysis. Numerical application to a particular example is carried out. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-29493# Naval War Coll., Newport, R. I.
SDI (STRATEGIC DEFENSE INITIATIVE): A POLICY ANALYSIS
Stephen O. Fought 1987 98 p
(AD-A194240) Avail: NTIS HC A05/MF A01 CSCL 05D

The contents of this report on SDI policy contains the following: Foundations of Deterrence; A Model for Stability; Analysis of SDI/Stability; Related Issues; Treatment of Implementation Factors; Historical Evolution and Trends; The Strategic Choices and Flexible Response; The Planners' Perspective; The Impact of Strategic Defense on a Strategy of Flexible Response; and Synthesis. GRA

N88-29494# Institute for Defense Analyses, Alexandria, Va.
STRATEGIC DEFENSE INITIATIVE ARCHITECTURE DATAFLOW MODELING TECHNIQUE VERSION 1.5 Final Report
Joseph L. Linn, Cy D. Ardoin, Cathy Jo Linn, Stephen E. Edwards, and Michael R. Kappel 22 Apr. 1988 142 p
(Contract MDA903-84-C-0031)
(AD-A194356; AD-E500963; IDA-P-2035; IDA/HQ-87-32623)
Avail: NTIS HC A07/MF A01 CSCL 15C

The Strategic Defense Initiative (SDI) Architecture Dataflow Modeling Technique (SADMT), a uniform formal notation for the description of SDI system architectures and Battle Management and Command, Control and Communications (BM/C3) architectures is presented. SADMT is a technique for thinking about and describing architectural processes and structures that use the typing and functional facilities of the Ada programming language. This document defines SADMT and the programming interface to the SADMT Simulation Facility (SADMT/SF). The issues addressed here are those relevant to providing formal descriptions of system structure and behavior for interface consistency checking, system simulation, and system evaluation. GRA

N88-29495# Institute for Defense Analyses, Alexandria, Va.
SDI (STRATEGIC DEFENSE INITIATIVE) BATTLE MANAGEMENT/C3 (COMMAND, CONTROL AND COMMUNICATIONS) ALGORITHMS TECHNOLOGY PROGRAM PLAN Final Report, Mar. - Nov. 1987
Gabriel Frenkel, Thomas S. Paterson, and Maile E. Smith Apr. 1988 99 p
(Contract MDA903-84-C-0031)
(AD-A194357; AD-E500970; IDA-P-2068; IDA/HQ-87-32185)
Avail: NTIS HC A05/MF A01 CSCL 15C

The Institute for Defense Analyses (IDA) has collected and analyzed information on battle management algorithm technology that is relevant to Battle Management/Command, Control and Communications (BM/C3). This Memorandum Report represents a program plan that will provide the BM/C3 Directorate of the Strategic Defense Initiative Organization (SDIO) with administrative and technical insight into algorithm technology. This program plan focuses on current activity in algorithm development and provides information and analysis to the SDIO to be used in formulating budget requirements for FY88 and beyond. Based upon analysis of algorithm requirements and ongoing programs, recommendations have been made for research areas that should be pursued, including both the continuation of current work and the initiation of new tasks. This final report includes all relevant material from interim reports as well as new results. GRA

N88-29496# Brown Univ., Providence, R. I. Center for Dynamical Systems.
MINIMIZING ESCAPE PROBABILITIES: A LARGE DEVIATIONS APPROACH
Paul Dupuis and Harold Kushner Oct. 1987 33 p
(Contract DAAL03-86-K-0171; Grants AF-AFOSR-0315-85; NSF DMS-85-11470; NSF ECS-85-05674)
(AD-A194534; LCDS/CCS-87-40; AFOSR-88-0393TR) Avail: NTIS HC A03/MF A01 CSCL 12I

This document considers the problem of controlling a possibly degenerate diffusion process so as to minimize the probability of escape over a given time interval. It is assumed that the control acts on the process through the drift coefficient, and that the noise coefficient is small. By developing a large deviations type theory for the controlled diffusion, the authors obtain several results. The limit of the normalized log of the minimum exit probability is identified as the value l of an associated (deterministic) differential game. Furthermore, the authors identify a deterministic (and epsilon independent) mapping g from the sample values epsilon w (s), 0 is less than or = S is greater than or = t, into the control space such that if we define the control used at time t by u(t) = g(epsilon w(s), 0 is greater than or = S , or = t), then the resulting control process is progressively measurable and delta optimal (in the sense that the limit of the normalized log of the exit probability is within delta of l). GRA

N88-29497# Army War Coll., Carlisle Barracks, Pa.
SDI (STRATEGIC DEFENSE INITIATIVE). WHERE DO WE GO FROM HERE
Robert R. Dierker 30 Mar. 1988 42 p
(AD-A194544) Avail: NTIS HC A03/MF A01 CSCL 15C

President Reagan's announcement five years ago of his vision for a Strategic Defense Initiative (SDI) has had strong implications for the United States nuclear strategy. Implementation of any or all parts of a strategic defense system would constitute a shift away from the offense-dominant strategy that the U.S. has espoused for over forty years. Effecting a shift in U.S. nuclear strategy while maintaining stability between the superpowers is an extremely difficult task. Opponents of SDI have raised the question of whether we should pursue SDI and the ensuing shift in strategy at all. The only real question to be answered is how to effect a

stable shift in U.S. strategy. The key to that shift is understanding and then considering the Soviets' views of SDI. The author discusses Soviet views of the U.S.'s Strategic Defense Initiative and then examines four possible U.S. options for SDI, ranging from unilateral deployment to use as a bargaining chip. GRA

N88-29498# Technion Research and Development Foundation Ltd., Haifa (Israel).
STOCHASTIC GAME APPROACH TO GUIDANCE DESIGN Interim Scientific Report, 1 Jun. - 30 Nov. 1987
J. Shinar 30 Nov. 1987 5 p
(Grant AF-AFOSR-3055-86)
(AD-A194574) Avail: NTIS HC A02/MF A01 CSCL 17G

This report covers the second phase of the research activity performed under AFOSR Grant No. 86-0355. The mixed strategy approach to guidance law design, proposed in this research program, has been applied in three-dimensional examples. The examples demonstrate that an optimal mixed three-dimensional strategy has to be developed by a genuine three-dimensional design procedure. GRA

N88-29499# Air Command and Staff Coll., Maxwell AFB, Ala.
SSTS (SPACE SURVEILLANCE AND TRACKING SYSTEM): THE IMPORTANCE OF EARLY TEST AND EVALUATION ORGANIZATIONAL PARTICIPATION
William T. Smith Apr. 1988 32 p
(AD-A193745; ACSC-88-2440) Avail: NTIS HC A03/MF A01 CSCL 14B

The early involvement of all participating organizations in the Test and Evaluation (T and E) process is important to the success of the weapon system development program. The identification of critical technological and test needs, particularly with respect to space systems, of both the weapon system and the ground test facility require early organizational participation. This study substantiates the need to involve all participating organizations early in the T and E process. It concludes that the guidance provided by the Department of Defense and the Air Force is clear and comprehensive. Test and Evaluation Master Plans and Test Planning Working Groups must be continually emphasized and utilized. With respect to test facilities, requirements must be identified early. Finally, the Space Surveillance and Tracking System (SSTS) development program provides an excellent example of how early participation by T and E experts contributed to the early identification of critical system and test facility components. GRA

N88-29500# Air Command and Staff Coll., Maxwell AFB, Ala.
THE PRINCIPLES OF MASS AND MANEUVER APPLIED TO SPACE OPERATIONS
Edward F. Teigeler Apr. 1988 68 p
(AD-A194037; ACSC-88-2540) Avail: NTIS HC A04/MF A01 CSCL 15F

Military space doctrine development has received considerable attention on how the principles of war apply to space operations. Many have argued that the principles of mass and maneuver do not apply, or that they apply only a very narrow sense. This study examines what the principles of war could bring to the development of military space doctrine, and analyzes recent positions on the applicability of mass and maneuver. The report concludes that the present positions on mass and maneuver are based on too limited definition of both principles, were considered only for the space segment, and used to narrow a definition of the theater of operations for space warfare. The report provides a summary of the concepts which make up mass and maneuver, and a space force structure for use in applying the principles. GRA

N88-29501# Illinois Univ., Urbana. Coordinated Science Lab.
ACTIVE EXPLANATION REDUCTION: AN APPROACH TO THE MULTIPLE EXPLANATIONS PROBLEM
Shankar A. Rajamoney and Gerald F. Dejong Apr. 1988 16 p
(Contract N00014-86-K-0309)
(AD-A194127; UILU-ENG-88-2218) Avail: NTIS HC A03/MF A01 CSCL 05B

The multiple explanations problem is central to explanation-based learning from imperfect theories. In this paper, we present a new approach called active explanation reduction to deal with this problem. Active explanation reduction involves the purposeful alteration of the world to generate new information. This new information with cause some of the explanations to become inconsistent with reality, thereby eliminating them from further consideration. Active explanation reduction may also be viewed as experiment design. This paper presents a theory of experiment design which is based on the principle of refutation. The theory describes three strategies for designing experiments: elaboration, discrimination and transformation. The theory and an experiment engine, an implementation of the theory, are illustrated using a detailed example which involves constructing explanations from intractable theories. The relation of the multiple explanations problem to the imperfect theory problems is also described. Finally, active explanation reduction is evaluated based on four criteria: completeness, efficiency, tolerance of unavailable data and feasibility. GRA

N88-29502# Army Combined Arms Center, Fort Leavenworth, Kans. Soviet Army Studies Office.
THE PROBLEM OF SPACE IN SOVIET OPERATIONAL ART Final Report
Jacob W. Kipp 1988 18 p
(AD-A194150) Avail: NTIS HC A03/MF A01 CSCL 15F

This assay provides commentary and context to the Soviet General Staff's approach to the study and preparation of space as an arena for the conduct of military actions. These comments are based on a lecture given by General-Major I.B. Shaposhnikov at the Voroshilov Academy of the General Staff in the mid 1970s and draw upon a larger study of these issues which was under taken by the author et al., Soviet Views on Military Operations in Space (1986). GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-29503# International Centre for Theoretical Physics, Trieste (Italy).
SEQUENTIAL APPROACH TO COLOMBEAU'S THEORY OF GENERALIZED FUNCTIONS
T. D. Todorov Jul. 1987 53 p
(DE88-701869; IC-87/126) Avail: NTIS (US Sales Only) HC A04/MF A01

J.F. Colombeau's generalized functions are constructed as equivalence classes of the elements of a specially chosen ultrapower of the class of the C(sup infinity) functions. The elements of this ultrapower are considered as sequences of C(sup infinity) functions, so in a sense, the sequential construction presented here refers to the original Colombeau theory just as, for example, the Mikusinski sequential approach to the distribution theory refers to the original Schwartz theory of distributions. The paper could be used as an elementary introduction to the Colombeau theory in which recently a solution was found to the problem of multiplication of Schwartz distributions. DOE

N88-29504# Wisconsin Univ., Madison. Center for Mathematical Sciences.
MONOTONE RECURRENCE RELATIONS, THEIR BIRKHOFF ORBITS AND TOPOLOGICAL ENTROPY Technical Summary Report
Sigurd B. Angenent Feb. 1988 47 p
(Contract DAAL03-87-K-0043)
(AD-A193481; CMS-TSR-88-25) Avail: NTIS HC A03/MF A01 CSCL 12B

A generalization of the class of monotone twistmaps to maps of S(sub 1 x)R(sub n) is proposed. The existence of Birkhoff orbits is studied, and a criterion for positive topological entropy is given. These results are then specialized to the case of monotone twist

maps. Finally it is shown that there is a large class of symplectic maps to which the foregoing discussion applies. GRA

N88-29505# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
ON THE QUANTIZATION OF CONSTRAINED GENERALIZED DYNAMICS
C. A. P. Galvao and N. A. Lemos 1987 22 p
(DE88-702223; CBPF-NF-060/87) Avail: NTIS (US Sales Only) HC A03/MF A01

A special class of degenerate second order Lagrangians, those which differ from a nondegenerate first order Lagrangian by a total time derivative (or a four divergence) of a function of both the coordinates and velocities, is studied in detail. The canonical quantization of such systems is then realized and it is shown that this leads to the same results as in the first order Lagrangian. DOE

N88-29506# Wisconsin Univ., Madison. Center for Mathematical Sciences.
FEEDBACK STABILIZATION OF du/dt=Au + bf IN HILBERT SPACE WHEN THE NORMALIZATION FUNCTION IS LESS THAN OR EQUAL TO r Technical Summary Report
Marshall Slemrod Sep. 1987 27 p
(Grants AF-AFOSR-0172-81; AF-AFOSR-0315-87)
(AD-A193510; CMS-TSR-88-7) Avail: NTIS HC A03/MF A01 CSCL 12I

This paper considers the feedback stabilization of a linear control system in an infinite dimensional state space. However unlike the standard feedback control problem where the goal is to find a linear feedback control law, we restrict ourselves to the case where the controls f(t) satisfy a certain a priori constraint. The author derives such a nonlinear feedback law based on energy stability methods. The analysis of the asymptotic behavior of the state u(t) is based on the theories of nonlinear evolution equations and contraction semigroups. While an earlier paper treated a related problem of sub-optimal control the results given here on feedback stabilization are new. A related optimal control problem was considered by Barbu. GRA

N88-29507# International Centre for Theoretical Physics, Trieste (Italy).
COSMOLOGY IN AN N-DIMENSIONAL VECTOR SPACE
G. E. Tauber Jul. 1987 9 p
(DE88-702550; IC-87/181) Avail: NTIS (US Sales Only) HC A02/MF A01

Previous results on a Geometrical Foundation for a Unified Field Theory are applied to the expanding universe. In the internal space the metric is chosen so that the curvature invariant depending on the internal variables is a constant (multiplied by a parameter depending on the space time variables), while the corresponding metric in the tangent space is that for a Friedmann universe of constant spatial curvature. The extra parameter is then determined from the consistency relations of the curvatures in the two spaces. Matter distributions can be taken into account by introducing a pressure p and density rho connected by an equation of state, such as p approx. rho. The codetermined equations for fields arising from geometrical considerations and for the radial scale function have been solved in the particular case of the field for a scalar meson, providing a possible source for the inflatory universe. DOE

N88-29508# International Centre for Theoretical Physics, Trieste (Italy).
ON NONLINEAR EQUATIONS ADMITTING SOLITON SOLUTIONS WITH A deBROGLIE PHASE
B. V. Baby and A. O. Barut Aug. 1987 22 p
(DE88-702694; IC-87/294) Avail: NTIS (US Sales Only) HC A03/MF A01

Some new classes of solutions are given for different families of nonlinear equations which have a localized envelope and a complex phase. Energy and momentum of these solutions and their possible applications as a model of a quantum particle are discussed. DOE

N88-29509# Leiden Univ. (Netherlands).
INVARIANT IDEALS OF MULTIPLICITY FREE ALGEBRAIC GROUP ACTIONS Ph.D. Thesis
Gijsbertus Cornelis Ruitenburg 1988 65 p
(B8803517; ETN-88-92894) Avail: NTIS HC A04/MF A01

The GL(n)-invariant ideals of the coordinate ring of pairs of symmetric matrices with product zero; multiplication of multivariable Jacobi polynomials; and invariant ideals of polynomial algebras with multiplicity free group action are discussed. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-29510# Los Alamos National Lab., N. Mex.
MATHEMATICAL THEORY AND CALCULATIONS OF MAGNETIC HYSTERESIS CURVES
M. L. Hodgdon 1988 16 p Presented at the Joint INTERMAG/Magnetism and Magnetic Materials Conference, Vancouver, British Columbia, 11 Jul. 1988
(Contract W-7405-eng-36)
(DE88-011055; LA-UR-88-1470; CONF-880703-1) Avail: NTIS HC A03/MF A01

The differential equation, dH = alpha times the absolute value of dB/dt (f(B) - H) + dB/dt g(B,B), in which the constant alpha and the material functions f and g are suitably restricted, forms a theory of rate-independent and rate-dependent hysteresis in ferrites, ferromagnetic materials, magnetic thin films, and permanent magnetic materials. The theory provides mathematical expressions for the initial magnetization curve, the anhysteretic curve, the major loop, the symmetric and asymmetric minor loops, and the energy loss associated with their traversal. Functional forms for f and g that can be scaled to measured values of the closure point, the remanence, the coercivity and, for rate-independent applications, the nonlinear changes in the loop area and energy loss that accompany increases in the rates dB/dt and dH/dt are discussed. By allowing the material parameters to depend on angle, the variations in loop shape and coercive point with angle observed in uniaxially anisotropic materials are described. Sample calculations are presented for representative materials. DOE

N88-29511# Harry Diamond Labs., Adelphi, Md.
EFFECTS ON THE RESONANT FREQUENCIES CAUSED BY LOADING A SPHERICAL CAVITY WITH A DIELECTRIC SPHERE Final Report
Louis F. Libelo, Guy E. Pisane, and Richard Ziolkowski Apr. 1988 95 p
(AD-A193864; HDL-TR-2130) Avail: NTIS HC A05/MF A01 CSCL 20C

An extensive investigation of the properties of a conducting spherical cavity filled with a lossless homogeneous dielectric and concentrically loaded with another lossless homogeneous dielectric was carried out. This report contains a portion of the results obtained in the course of this investigation. Also presented and discussed are the effects on the cavity system eigenvalues of changing the radius of the dielectric load sphere. This is done for a wide range of relative dielectric strength for the media within the cavity. Specifically, results for relative strengths of 3, 10, and 1/3 are given. The appropriate derivations of the eigenvalue equations are presented. Analysis of the results suggests a broad variety of practical applications. GRA

N88-29512# International Centre for Theoretical Physics, Trieste (Italy).
GREEN'S FUNCTION APPROACH TO ROUGHENING TRANSITION OF ONE-DIMENSIONAL RESTRICTED SOLID ON SOLID MODEL
Jiancheng Lin Sep. 1987 33 p
(DE88-702723; IC-87/331) Avail: NTIS (US Sales Only) HC A03/MF A01

In this paper by mapping a one-dimensional (1-D) restricted solid on solid (RSOS) model to a tight binding Hamiltonian (TBH) system, we use Green's function method in a systematical way, to predict roughening transition point for the model with infinite, semi-finite and finite boundaries and with the presence of external attractive pinning potential at any one or two rows. Green's functions for the TBH systems with semi-finite and finite boundaries are derived by an appending-breaking way. Phase diagrams which give detailed information about the roughening transition are given in the parameters space. DOE

N88-29513# Groningen Rijksuniversiteit (Netherlands).
UNFOLDINGS OF QUASI-PERIODIC TORI Ph.D. Thesis
Gregorius Bonifatius Huitema 1988 120 p
(Contract ZWO-10-70-10)
(B8811118; ETN-88-92901) Avail: NTIS HC A06/MF A01

Families of dynamical systems having invariant tori with parallel, and more specifically, quasi-periodic motions are studied. Questions of persistence and stability of such motions under small perturbations of these families are considered. An example from nonlinear oscillations is presented, to give a general impression of the theory. Persistence or stability results in the general (dissipative) and the conservative contexts are shown. It appears that these results admit a quite general (unified) formulation in terms of Lie algebra, which also leaves open the possibility of further generalization. ESA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution*.

N88-29514*# Duke Univ., Durham, N. C. Dept. of Mechanical Engineering and Materials Science.
ASYMPTOTIC MODAL ANALYSIS AND STATISTICAL ENERGY ANALYSIS Progress Report, 15 Oct. 1987 - 14 Apr. 1988
Earl H. Dowell 21 Jul. 1988 110 p
(Grant NAG1-709)
(NASA-CR-183077; NAS 1.26:183077) Avail: NTIS HC A06/MF A01 CSCL 20A

Statistical Energy Analysis (SEA) is defined by considering the asymptotic limit of Classical Modal Analysis, an approach called Asymptotic Modal Analysis (AMA). The general approach is described for both structural and acoustical systems. The theoretical foundation is presented for structural systems, and experimental verification is presented for a structural plate responding to a random force. Work accomplished subsequent to the grant initiation focusses on the acoustic response of an interior cavity (i.e., an aircraft or spacecraft fuselage) with a portion of the wall vibrating in a large number of structural modes. First results were presented at the ASME Winter Annual Meeting in December, 1987, and accepted for publication in the Journal of Vibration, Acoustics, Stress and Reliability in Design. It is shown that asymptotically as the number of acoustic modes excited becomes large, the pressure level in the cavity becomes uniform except at the cavity boundaries. However, the mean square pressure at the cavity corner, edge and wall is, respectively, 8, 4, and 2 times the value in the cavity interior. Also it is shown that when the portion of the wall which is vibrating is near a cavity corner or edge, the response is significantly higher. Author

N88-29515# Georgia Inst. of Tech., Atlanta.
THE ACOUSTIC FIELD SCATTERED FROM SOME APPROXIMATE PRESSURE RELEASE MATERIALS Ph.D. Thesis
Gary W. Caille Mar. 1988 210 p
(Contract N00228-85-G-3247)
(AD-A194768) Avail: NTIS HC A10/MF A01 CSCL 20A

The objective was to determine if a pressure release boundary condition can be achieved by coating an elastic shell with a visco-elastic material. One necessary condition is that the coating must acoustically decouple the shell from the scattering problem. Two closed cell rubbers and two cork-rubber composites (nitrile and neoprene based) were investigated. The dynamic viscoelastic constants of the materials were determined by wave propagation techniques. The far field scattering form functions for an infinite cylindrical shell coated with the viscoelastic material were calculated using the complete elastic equations of motion. The form functions were experimentally measured for the different materials at different thicknesses as verification of the theory. A thick finite right cylindrical shell was coated with .25 inches of closed cell neoprene and the normalized scattered pressure measured. The pressure release normalized scattered pressure was determined for the end on incident plane wave case using the acoustic radiation Simplified Helmholtz Integral Program (SHIP). GRA

N88-29516# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF ACOUSTIC CAVITATION PRODUCED BY PULSED ULTRASOUND M.S. Thesis
Robert L. Bruce, Jr. and Robert D. Middleton, Jr. Dec. 1987 95 p
(AD-A193523) Avail: NTIS HC A05/MF A01 CSCL 20A

Transient cavitation produced by pulsed ultrasound in the MHz range has been investigated. First, a theoretical background which develops bubble motion in general and focuses specifically on transient cavitation is presented. Second, the development of an apparatus which is designed specifically for studying this type of cavitation is discussed. Third, the use of the apparatus to make measurements of cavitation thresholds at various frequencies, pulse durations, and pulse repetition rates is discussed. Finally, results of the cavitation threshold measurements are interpreted using theories developed earlier. GRA

N88-29517# Naval Ocean Systems Center, San Diego, Calif.
REFLECTION AND SCATTERING OF ACOUSTIC RAYS COMPUTED FOR PARABOLIC ICE KEEL MODELS Research Report, Oct. 1986 - Oct. 1987
D. F. Gordon Apr. 1988 21 p
(AD-A193898; NOSC/TR-1217) Avail: NTIS HC A03/MF A01 CSCL 20A

Coefficients are computed for ray reflection and scattering from a model of a set of keels. The model is a collection of parallel ice keels that are of parabolic cross section. The size of the keels and the spacing between them are drawn from random distributions. The keels are also widened by a random factor to simulate oblique incidence on nonparallel keels. Rays are permitted to reflect from and refract through keels according to the interface properties between fluids and elastic solids. A large number of rays are directed toward the keel model and, upon emergence, are sorted into angular bins to determine scattering strength versus direction. Scattering coefficients have a dominant lobe near the secular direction. This is shown to result from the shape of the curve of reflection versus grazing angle. Very little backscatter occurs, a result of the limited slope angle of the parabolic keel models. GRA

N88-29518# Naval Postgraduate School, Monterey, Calif.
ACOUSTIC PRESSURE DISTRIBUTION ON THE BOTTOM OF A WEDGE-SHAPED OCEAN M.S. Thesis
Yu-Ming Li Dec. 1987 102 p
(AD-A193961) Avail: NTIS HC A06/MF A01 CSCL 20A

The pressure amplitude distribution along the interface between a wedge-shaped fluid layer overlying fast and slow fluid bottoms

were investigated using compute models based on the method of images. The pressure amplitude along the bottom rapidly falls off for distances closer to the apex than that at which adiabatic-mode theory predicts cut-off for the lowest mode. This distance is termed the dump distance for an acoustically fast-bottom condition. In the case of a slow bottom, because the speed of sound ratio is greater than 1, the dump distance does not exist. To facilitate scaling the acoustic fields, a scaling distance is introduced.
GRA

N88-29519# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
ASKA-ACOUSTICS: THEORY AND APPLICATIONS
Peter Goransson Feb. 1988 93 p
(Contract FFA-STU-HU-2812)
(FFA-TN-1988-13; ETN-88-92808) Avail: NTIS HC A05/MF A01

Analysis of acoustic problems with the tools provided in ASKA-acoustics programs is explained. Finite element modeling of the physical problem is considered. The material parameters which are needed to describe different fluid models are discussed. The actual technique of substructuring fluid-structure interaction problems is considered. The implementation in ASKA-acoustics is quite general with all major steps similar to an ordinary structural analysis. The analysis of a fluid-structure interaction problem is, however, numerically troublesome and the ways of handling this are treated. The excitation of the fluid is outlined, along with analysis paths. The results presentation, and the tools provided to make them accessible are summarized. Application examples are given.
ESA

N88-29520# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
ANALYSIS OF THE TRANSMISSION OF SOUND INTO THE PASSENGER COMPARTMENT OF A PROPELLER AIRCRAFT USING THE FINITE ELEMENT METHOD
Peter Goransson Mar. 1988 16 p Presented at the 3rd International Conference on Advances in Structural Dynamics, Southampton, England, Jul. 1988
(Contract FFA-STU-HU-2812)
(FFA-TN-1988-15; ETN-88-92809) Avail: NTIS HC A03/MF A01

The double wall construction of an aircraft cabin was analyzed to see if sound transmission phenomena found in experiments can be reproduced. The eigenvalues and eigenmodes of the plane cross section were calculated, with and without the inner trim pannels, emphasizing the effects of different attachment of the trim panels to the frames and also of the weight and stiffness of the trim panels. The calculated modes were used to calculate the sound levels arising from an external pressure field acting on the outer shell. The analysis is performed with the finite element system ASKA-acoustics. The intervention between the structural parts and the fluid in the different cavities is modeled with a symmetric coupling formulation with pressure and displacement potential as fluid degrees of freedom. The acoustic field is modeled with special acoustic finite elements and the coupling to the structure is handled with interface elements. Analysis of an aircraft cross section shows that the transmission of low frequency sound is strongly dependent on the dynamics of the fuselage-air-trim-air system. The maximum SPL may vary from 123 down to 118 dB in the extreme cases where only attachment and density of the trim panel are changed. The results also show that a porous absorbent in the air space may give an additional decrease down to a maximum of 114 dB by carefully tuning the mass density of the porous material. ESA

N88-29521# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
OVERVIEW OF COMPUTATIONAL VIBRO ACOUSTICS. STATE OF THE ART AND FUTURE DEVELOPMENT
Peter Goransson Mar. 1988 32 p
(Contracts FFA-STU-HU-2812; FFA-SAAB-HU-2857; S-S-28-7-86048)
(FFA-TN-1988-17; ETN-88-92810) Avail: NTIS HC A03/MF A01

Acoustic fluid modeling; fluid-structure interaction modeling; damping in vibro acoustic analysis; modal and frequency based solutions methods; and development needs are discussed. ESA

N88-29522# Southampton Univ. (England). Inst. of Sound and Vibration Research.
EXPERIMENTS ON THE DISSIPATION OF SOUND BY SEPARATED FLOW AT AN EDGE
M. S. Vasudevan, P. A. Nelson, and M. S. Howe Feb. 1988 43 p Sponsored by the United Kingdom Science and Engineering Research Council
(ISVR-TR-151; ETN-88-92823) Avail: NTIS HC A03/MF A01

Attenuation of sound by the production of vorticity at edges was studied. A system of plane acoustic waves is generated in a mean flow duct containing a splitter plate. The waves are phased to produce a reciprocating flow about the trailing edge of the plate, or through a transverse slot in the plate. Energy is transferred between acoustic and vortical modes when the sound induces vortex shedding at the edges. The resulting net change in the acoustic energy is measured and compared with theoretical predictions. Although significant acoustic attenuation is observed with and without mean flow, there is no consistent agreement with theory.
ESA

N88-29523# Southampton Univ. (England). Inst. of Sound and Vibration Research.
A COMPARISON OF SIMPLE ANALYTICAL MODELS FOR REPRESENTING PROPELLER AIRCRAFT STRUCTURAL AND ACOUSTIC RESPONSES
A. J. Bullmore Feb. 1988 127 p Sponsored by the Department of Trade and Industry, London, England
(ISVR-TR-153; ETN-88-92824) Avail: NTIS HC A07/MF A01

The effectiveness of active noise control applied to reduce the internal sound pressure levels in the cabin of propeller driven aircraft, specifically the BAe 748 aircraft, was examined. The model is required only to produce results for frequencies below 200 Hz, the range of the greatest effectiveness of the noise control system. The chosen model consists of a finite aluminum cylinder, 16 m long, 1.3 m radius, with a structural damping factor of 0.3. It is excited by an external pressure field. The internal acoustic field is modeled by a cylindrical room acoustics model excited by the normal vibrations of the shell wall, but only over a region extending from z=1.5 to 12.5 m, and from theta = 60 to 300 deg. The cylindrical room is assumed to have the same length and radius as the structural cylinder model.
ESA

N88-29524 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
NOISE LEVELS FROM A JET-ENGINED AIRCRAFT MEASURED AT GROUND LEVEL AND AT 1.2 M ABOVE THE GROUND
R. C. Payne Jan. 1988 42 p
(NPL-AC-114; ISSN-0143-7143; ETN-88-93141) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingtom

During flight tests using a British Aerospace HS125-700, noise measurements were obtained using microphones close to the ground plane and at a height of 1.2 m. Substantial differences from ground level to 1.2 m in measurements of perceived noise level and effective perceived noise level were observed. The differences depend on ground cover and flight maneuver. The ground-plane microphones generally produce noise levels which closely approximate pressure-doubled values. A procedure for correcting 1/3-octave band sound pressure levels measured 1.2 m above the ground, to obtain pressure-doubled levels, was examined. The procedure is successful when used in adjustments of perceived noise levels but, because of inaccurate estimates of duration corrections, is less suitable in the case of effective perceived noise level, especially for aircraft in approach to landing. It is concluded that to avoid significant variations in measured

noise levels measurements should be made using a ground-plane microphone. ESA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-29525# International Centre for Theoretical Physics, Trieste (Italy).
ELECTRON IMPACT IONIZATION CROSS-SECTION OF SOME ORGANIC COMPOUNDS
A. N. Pandey and R. K. Sharma Apr. 1987 11 p
(DE88-702044; IC-87/60) Avail: NTIS (US Sales Only) HC A03/MF A01

The total ionization cross-section is computed for methane, ethane and their halogen derivatives using mean molecular polarizability, a(sub M). The dependence of ionization cross-section on mean molecular polarizability is discussed. The additivity of cross-section of different bonds in a molecule is also discussed. The method has the advantage of estimating total ionization cross-section for molecules whose a(sub M) is not known. This is illustrated for carbon tetra chloride. DOE

N88-29526# International Centre for Theoretical Physics, Trieste (Italy).
ON SELECTION RULES AND INELASTIC ELECTRON SCATTERING AT INTERMEDIATE ENERGIES
K. Nuroh Dec. 1986 15 p
(DE88-701833; IC-86/332) Avail: NTIS (US Sales Only) HC A03/MF A01

Correlation effects are included in the Bethe-Born theory for the generalized oscillator strength of inelastic scattering of electrons on atoms. The formulation is such as to allow for the calculation of relative line strengths of multiplets. It is used to analyze line strengths of the 4d - less than 4f transition in La(sup 3(+)) and Ce(sup 4(+)) within LS-coupling. The analysis indicates that only singlet states of the intermediate 4d(sup 9)4f configuration are allowed. Calculated line strengths are compared with a recent core electron energy loss spectra of metallic La and tetravalent CeO(sup 2) and there is an overall qualitative agreement between theory and experiment. DOE

N88-29527# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
MEASUREMENTS OF XeF (XENON FLUORIDE) GROUND STATE DISSOCIATION AND VIBRATIONAL EQUILIBRATION
J. F. Bott, R. F. Heidner, J. S. Holloway, J. B. Koffend, and M. A. Kwok 25 Mar. 1988 41 p Previously announced in IAA as A88-43782
(Contract F04701-85-C-0086)
(AD-A194611; TR-0088(3930-04)-1; SD-TR-88-54) Avail: NTIS HC A03/MF A01 CSCL 07B

The removal rates of the lower levels of the laser transitions affect the efficiency of the XeF excimer laser performance. We have deduced the removal rates of XeF(X,v) in argon, helium, and neon by measuring the populations of v = 0 and 1 vibrational levels formed by the photolysis of XeF2. The time history of each vibrational population is monitored with a CW tunable dye laser tuned to an absorption feature of the selected vibrational/rotational level. The studies show a rapid vibrational relaxation of v = 0 and v = 1 levels followed by a common decay rate of the two levels. Helium and neon were found to remove these levels with the same rate coefficient of (2.0 + or - 0.2) x 10 to the 4th/(sec-Torr)-1 at room temperature. The rate coefficient for argon were faster by about 25 percent. The removal rate coefficients increased with temperature in the range of 23 to 95 C. GRA

N88-29528# Naval Postgraduate School, Monterey, Calif.
DIFFRACTION TRANSITION RADIATION FROM PERIODIC ELECTRON BUNCHES M.S. Thesis
Young M. Lee Dec. 1987 71 p
(AD-A193593) Avail: NTIS HC A04/MF A01 CSCL 20H

Measurements of the first lobe of diffraction transition radiation from a hole in a thin aluminum foil for electron-beam energies of 32.9 MeV and 63.3 MeV has been made. The effect of the hole size was investigated using radii of 3, 5, and 7 cm. Although the measured peak angle and intensity are not well matched to the theoretical values, these experiments attempt to isolate the diffraction transition radiation from Cerenkov radiation and transition radiation. The normalization of the detected signal to the beam current was tried for compensation of the beam fluctuation. Conclusive results have not yet been obtained, but this investigation provides directions for future experiments. GRA

N88-29529# Mitre Corp., McLean, Va.
NEUTRINO DETECTION PRIMER
C. Callan, F. Dyson, and S. Treiman Mar. 1988 95 p
(Contract F19628-86-C-0001)
(AD-A193805; JSR-84-105) Avail: NTIS HC A05/MF A01 CSCL 20H

This report is intended to provide for non-expert readers a survey of natural and manmade neutrino sources and a critical review of various methods proposed for their detection. Detection methods may be divided into two classes, those which have very modest performance and might actually work, and those which promise spectacular performance but violate the laws of physics. Emphasis in this report is on the second. The purpose is not to describe in detail what is possible, but to establish firm limits beyond which all schemes for detection capability are impossible. The last two sections of the report are for advanced students only and should be skipped by the non-expert. They provide precise mathematical statements and proofs of the limits which the laws of physics impose on neutrino cross sections. The limits are neither simple nor obvious. Consequently, it may be useful to have their technical justification here put on record. GRA

N88-29530# Technion Research and Development Foundation Ltd., Haifa (Israel).
COOPERATIVE EFFECTS AND INTRINSIC OPTICAL BISTABILITY IN COLLECTIONS OF ATOMS Interim Report No. 2, 1 Dec. 1987 - 31 Mar. 1988
Y. Ben-Aryeh 31 Mar. 1988 2 p
(Contract DAJA45-87-C-0040)
(AD-A193993; R/D-5859-PH-01) Avail: NTIS HC A02/MF A01 CSCL 07D

The effect of the coherent dipole-dipole interactions on the resonance fluorescence spectra of two, two-level atoms, driven by a coherent external field, has been investigated. The explicit dependence of the coherent dipole-dipole interactions on the distance between the treatment of the spectra. For the case of two, two-level atoms with a fixed distance smaller than a wavelength an analytical result for the resonance fluorescence line shape has been obtained and the result has been compared with previous works. The Langevin Equations for Intrinsic Bistability, the effects of the Langevin noise terms on intrinsic bistability are analyzed for the case in which dephasing constant is large relative to that of the relaxation. Within this approximation one dimensional Ito differential equation for the inversion of population has been developed. The tunneling process and the passage times between the two stable states in the intrinsic bistability are studied. GRA

N88-29531# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
WEAK INTERACTION PHYSICS: FROM ITS BIRTH TO THE ELECTROWEAK MODEL
J. Leite Lopes 1987 65 p
(DE88-702494; CBPF-NF-039/87) Avail: NTIS (US Sales Only) HC A04/MF A01

A review of the evolution of weak interaction physics from its beginning (Fermi-Majorana-Perrin) to the electroweak model (Glashow-Weinberg-Salam). Contributions from Brazilian physicists are especially mentioned as well as the first prediction of

electroweak-unification, of the neutral intermediate vector Z sub 0 and the first approximate value of the mass of the W-bosons. DOE

N88-29532# Leiden Univ. (Netherlands).
NUCLEAR MAGNETIC ORDERING AND PARAMAGNETIC RELAXATION OF DIATOMIC MOLECULES IN Ca (OH)2 Ph.D. Thesis
Gerardus Dominicus F vanVeizen 1986 88 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(B8681469; ETN-88-92898) Avail: NTIS HC A05/MF A01

The Raman electron spin-lattice relaxation process for diatomic molecules: theory for Ca(OH)2 : O2(-); the Raman electron spin-lattice relaxation process for diatomic molecules: experiments in Ca(OH)2 : O2(-); and the nuclear magnetic phase diagram of Ca(OH)2 at negative spin temperatures are discussed. ESA

N88-29533# Leiden Univ. (Netherlands).
STATIC AND DYNAMIC BEHAVIOR OF A QUASI ONE-DIMENSIONAL HEISENBERG ANTIFERROMAGNET IN THE LONG-RANGE ORDERED STATE. A NUCLEAR MAGNETIC RESONANCE STUDY PERFORMED WITH A He3-He4 DILUTION REFRIGERATOR Ph.D. Thesis, 17 Dec. 1986
Johannes Cornelis Voorhoeve 1987 145 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(B8705564; ETN-88-92899) Avail: NTIS HC A07/MF A01

Nuclear spin-lattice relaxation at very low temperatures; continuous wave experiments on CuSO4.5H2O in the ordered and disordered state; and proton relaxation above and around the phase transition are discussed. ESA

N88-29534# Leiden Univ. (Netherlands).
FLUCTUATION AND RELAXATION PHENOMENA STUDIED BY MEANS OF NUCLEAR ORIENTATION Ph.D. Thesis
Willem vanRijswijk 1986 122 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(B8679671; ETN-88-92900) Avail: NTIS HC A06/MF A01

Radiative detection of nuclear orientation; experiments on cerium alloys and compounds; and nuclear spin-lattice relaxation of guest atoms in iron were studied. ESA

N88-29535# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
STUDY OF BIOLOGICAL EFFECTS AND RADIATION PROTECTION TO FUTURE EUROPEAN MANNED SPACE FLIGHTS Final Report
J. Bourrieau, J. Berry, J. P. Philippon, M. Roux, G. Reitz, R. Facius, M. Schafer, J. U. Schott, H. Bucker, and G. Horneck et al. Paris, France ESA 1 Feb. 1988 325 p Prepared in cooperation with ONERA, Paris France; DFVLR, Cologne, Fed. Republic of Germany; National Radiological Protection Board, Harwell, United Kingdom; Observatoire de Paris-Meudon, France; Battelle Inst., Frankfurt am Main, Fed. Republic of Ger
(Contract ESA-6988/86-NL-PP(SC))
(DGT-33061; ESA-CR(P)-2553; ETN-88-92775) Avail: NTIS HC A14/MF A01

The Earth's radiation environment; radiation dose calculation and measurement; foreseen exposure in European manned space missions; biological effects of radiation; and radiation monitoring and protection are discussed. ESA

N88-29536# Amsterdam Univ. (Netherlands).
DISPERSION EFFECTS IN ELASTIC ELECTRON SCATTERING FROM C12 Ph.D. Thesis
Edmond Arnold Jean M Offermann 1988 118 p Sponsored by the Foundation for Fundamental Research on Matter, The Netherlands and the Netherlands Organization for the Advancement of Pure Research
(B8805297; ISBN-90-9002053-5; ETN-88-92892) Copyright Avail: NTIS HC A06/MF A01

An experiment to investigate to what extent dispersion effects contribute to the reaction mechanism of elastic electron scattering from C12 is described. The study of the elastic C12 cross sections in the one-photon exchange formalism demonstrates unambigously the existence of a form-factor energy dependence of 8 percent in the first diffraction minimum between an incident energy of 240 and 430 MeV. A sufficiently large momentum-transfer range was covered to show that also outside the diffraction minimum the one-photon exchange treatment fails to describe the experimental data. Here, discrepancies of 3 percent are observed between the date sets at the two incident energies. However, the observed energy dependence in the diffraction minimum has a different sign than outside the minimum. In the diffraction minimum the dispersive contributions increase with energy. The observed discrepancies in the one-photon exhcange analysis do not allow to neglect dispersive contributions in high-precision elastic electron-scattering data. Their effect on the ground-state charge distribution is shown to be comparable to that of experimental uncertainties in the absolute normalization and in the momentun scale. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-29537# Los Alamos National Lab., N. Mex.
MOMENT INVARIANTS FOR PARTICLE BEAMS
W. P. Lysenko and M. S. Overley 1988 14 p Presented at the Workshop on Accelerator and Beam Optics Codes, San Diego, Calif., 19 Jan. 1988
(Contract W-7405-eng-36)
(DE88-011052; LA-UR-88-1545; CONF-880178-7) Avail: NTIS HC A03/MF A01

The rms emittance is a certain function of second moments in 2-D phase space. It is preserved for linear uncoupled (1-D) motion. In this paper, the authors present new functions of moments that are invariants for coupled motion. These invariants were computed symbolically using a computer algebra system. Possible applications for these invariants are discussed. Also, approximate moment invariants for nonlinear motion are presented. DOE

N88-29538# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
THEORETICAL STUDIES IN HIGH ENERGY PHYSICS Final Technical Report
E. Braaten 1988 7 p
(Contract DE-FG02-85ER-40228)
(DE88-011606; DOE/ER-40228/T1) Avail: NTIS HC A02/MF A01

The research activities that were supported by this grant were focused primarily on low energy quantum chromodynamics. Significant progress was made in the Skyrme model for baryons, string models for color flux tubes, hadronic decays of the /tau/ lepton, technicolor models of the electroweak interactions, and meson form factors in perturbative QCD. DOE

N88-29539# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN ANALYSIS OF HEAT TRANSFER AFTER LOSS OF PRIMARY COOLANT IN THE SP-100 REACTOR SYSTEM M.S. Thesis
Donald W. Robbins Mar. 1988 75 p
(AD-A194619; AFIT/GNE/ENP/88M-8) Avail: NTIS HC A04/MF A01 CSCL 18I

This study determines design guidelines for the SP-100 space reactor core cooling system after a loss of coolant accident. The Thermal Systems Analysis Code (TSAP) calculated the temperatures within the fuel assemblies as a result of the fuel decay heat. TSAP is a lumped-parameter network analysis code capable of performing radiative and conductive heat transfer analysis. The reactor core was assumed to void of coolant

instantaneously following a LOCA. The reactor core model consisted of individual fuel pin assemblies containing 36 fuel pins surrounding a central cooling channel. This central cooling channel, or bayonet, is a secondary cooling loop within the reactor core. The bayonet cooling is a safety feature designed to keep the core from reaching temperatures at which the uranium dissociates from the uranium-nitride fuel. TSAP calculated the fuel pin temperatures due to decay heat transient. The performance of the bayonets within a generic reactor core was compared to an actual design. Design guidance was established based on the performance of the bayonets in the generic core. GRA

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N88-29540 Rochester Univ., N. Y.
OPTICAL EMISSION FROM SURFACE WAVES SUPPORTED IN THIN METAL FILMS Ph.D. Thesis
Russell Wayne Gruhlke 1987 211 p
Avail: Univ. Microfilms Order No. DA8803316

An experimental investigation of the properties of the surface plasmon modes supported by several thin-metal-film geometries is described. Surface plasmons can be thought of as tranverse magnetic (TM) polarized electromagnetic waves associated with one or both of the surfaces of a thin metal film. The experimental investigation of surface plasmon phenomena in thin metal films was, for the most part, restricted to optical absorption experiments at the Helium-Neon laser wavelength lambda = 632.8 nm. This thesis makes use of the interaction between surface plasmons and nearby molecules and the grating-induced radiative decay of surface plasmons to explore the properties of surface plasmons in optical emission experiments over an appreciable wavelength range. These techniques have proved to be powerful tools with which to probe the mode content of metal films. Corrugated thin silver film samples were fabricated and characterized by the degree of refractive index asymmetry of the dielectric media surrounding the metal film. Dissert. Abstr.

N88-29541 Rochester Univ., N. Y.
INVESTIGATION OF NON-CLASSICAL EFFECTS IN TWO-PHOTON INTERFERENCE PROCESSES Ph.D. Thesis
Rupamanjari Ghosh 1987 124 p
Avail: Univ. Microfilms Order No. DA8803314

Some non-classical and non-local effects in two-photon interference processes are investigated theoretically and experimentally. When the sources of the two photons are randomly phased, ordinary second-order interference effects disappear, but higher-order effects may still be present. Fourth-order interference effects, that can be established by observing intensity correlations rather than in the intensity itself, are predicted even classically for two independent sources. But quantum mechanical theory predicts much stronger correlations than those possible from classical considerations. The results of an interference experiment on down-conversion are presented where the laws of classical probability are shown to be violated by a significant degree. When the sources for the interference experiment are just two fully excited atoms, emitting spontaneously and hence independently of each other, there are no second-order interference effects, but fourth-order interference effects are predicted theoretically. By selecting two atoms at an intermediate point of their Rabi oscillation cycle, i.e., when the two atoms are subject to the same degree of partial excitation, second-order interference effects should be observed. Dissert. Abstr.

N88-29542# Naval Postgraduate School, Monterey, Calif.
LONG HAUL UNDERWATER FIBER OPTIC LINK M.S. Thesis
Frank A. Denaps Mar. 1988 79 p
(AD-A194487) Avail: NTIS HC A05/MF A01 CSCL 20F

This thesis presents the design test and evaluation of a fiber optic remote monitoring system. Practical aspects of loss measurement, link analysis, receiver design, and controller implementation are examined. The fundamental operation of the system relies on conversion of the voltage data to be a variable frequency TTL pulse train. The pulse train modulates a 1300 nm laser, which transmits the telemetry data via single mode fiber to the shore station. One of the two test voltages can be selected by the shore-based controller, via the bidirectional link. Laboratory test results are included. GRA

N88-29543# Oklahoma State Univ., Stillwater. Dept. of Physics.
PHOTOREFRACTIVE DAMAGE MECHANISM IN ELECTRO-OPTIC MATERIALS Annual Report, 15 Jul. 1987 - 15 Feb. 1988
Larry E. Halliburton 1 Mar. 1988 18 p
(Grant AF-AFOSR-0270-85)
(AD-A194560; AFOSR-88-0451TR) Avail: NTIS HC A03/MF A01 CSCL 20E

The photo-induced redistribution of charge has been characterized in Bi(sub 12)SiO(sub 20) and Bi(sub 12)GeO(sub 20) crystals using electron spin resonance, thermally stimulated luminescence, and optical absorption techniques. Our results suggest that Fe(3+) ions play an important role in the photorefractive effect in these materials. GRA

N88-29544# Weizmann Inst. of Science, Rehovoth (Israel).
QUASI-LIQUID CRYSTALLINE MATERIALS WITH SPECIAL ELECTRO-OPTIC PROPERTIES Periodic Report No. 5, Jun. - Nov. 1987
Valeri Krongauz Nov. 1987 10 p
(Contract DAJA45-85-C-0030)
(AD-A194579) Avail: NTIS HC A02/MF A01 CSCL 07C

During the past six months we have completed synthesis and investigation of side chain liquid crystal polysiloxanes containing photochromic spiropyran side groups (Item C, Section 4 of the Research Proposal). The polymers exhibit both thermo- and photochromic properties. By changing temperature and wavelength of light we could control the polymer color. Three primary colors (yellow, blue and red) were obtained. The color changes stemmed from spiropyran-merocyanine conversion and aggregation of the merocyanine side groups. Our research plans include further examination of optical properties of the photo-thermochromic liquid crystal polymers, including laser irradiation effects. GRA

N88-29545# Rochester Univ., N. Y. Inst. of Optics.
CENTER FOR OPTO-ELECTRONIC SYSTEMS RESEARCH INSTRUMENTATION GRANT Final Report, 10 Oct. 1986 - 14 Nov. 1987
Nicholas George 1 Feb. 1988 12 p
(Contract DAAL03-86-G-0201)
(AD-A193711; ARO-24627.1-PH-VIE) Avail: NTIS HC A03/MF A01 CSCL 09E

This final report contains a listing of capital equipment purchased by the ARO-URI Center for Opto-Electronic Systems Research during Year 1 of the Center. This equipment is being used to support the research of 12 faculty investigators and 20 doctoral scholars in the following areas: (1) signal processing and image understanding, (2) optical system design, and (3) sources and sensors for optoelectronic systems. Author (GRA)

N88-29546# Pennsylvania Univ., Philadelphia.
NONLINEAR OPTICAL PROCESSES IN MOLECULAR SYSTEMS Final Report, 9 May 1983 - 30 Oct. 1987
Robin M. Rochstrasser 15 Jan. 1988 6 p
(Contract DAAG29-83-K-0075)
(AD-A193871; ARO-19750.7-PH) Avail: NTIS HC A02/MF A01 CSCL 20E

Ultrafast processes in condensed matter are studied by the various nonlinear optical spectroscopic methods. Work was completed in areas involving: the theory of strong field effects; the separation of fluorescence and Raman scattering; the effects of condensed matter fluctuations on Raman; fully resonant second harmonic generation; Dice effects in chi(squared); analysis of third

order responses for rotating dipoles; picosecond studies of molecular reorientation; subpicosecond responses of metal particles to light; and effects of ultrahigh intensity pulses on the Raman spectral shape. GRA

N88-29547# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
BEAM COMBINING BY PHASE TRANSITION NONLINEAR MEDIA Semiannual Interim Report No. 1, 1 Jun. 1987 - 31 Jan. 1988
Victor Wang and Pete Roullard 4 Mar. 1988 26 p
(Contract N00014-87-C-0340)
(AD-A194116) Avail: NTIS HC A03/MF A01 CSCL 17E

Rocketdyne, a division of Rockwell International is conducting this research program to study, develop, and demonstrate the use of a gas or liquid near a phase transition as an efficient phase conjugation material. We expect to observe enhanced efficiencies of Degenerate Four Wave Mixing (DFWM) and Stimulated Brillouin Scattering (SBS) in liquids undergoing cavitation (also referred to as incipient or nucleate boiling or as superheated) or in gases undergoing supersaturated (supercooled) condensation. We will achieve these nonequilibrium conditions via the sudden pressure drop obtained by flowing the fluid through a nozzle. Since the change of state from liquid to gas can be made to occur more readily near the fluid's critical point as compared with other conditions, we are choosing to work with fluids whose critical points are near room temperature, thus simplifying problems of thermal control. GRA

N88-29548# Technische Hogeschool Twente, Enschede (Netherlands).
INVESTIGATIONS ON PERIODICALLY PERTURBED OPTICAL WAVEGUIDES Ph.D. Thesis
Winfried Henri Gerar Horsthuis 1987 123 p Sponsored in part by the Netherlands Technology Foundation
(B8712725; ISSN-90-71382-11-7; ETN-88-92893) Copyright
Avail: NTIS HC A06/MF A01

The development of optical sensors based on periodically perturbed waveguides is discussed. Work was carried out on planar integrated optical structures in which such perturbations were realized by means of the linear electro-optic effect in thin zinc oxide films. The working of two types of electro-optical modulators, namely a planar Bragg deflector and a mode coupler in a multilayer waveguide is described. Optimization of the ZnO sputtering deposition method is summarized. Despite the crystalline character of the layers a low optical attenuation on the order of 2 dB/cm, is obtained. The optical properties agree very well with those of single crystal bulk material. The influence of periodic distortions in a graded-index optical fiber (microbending) is assessed. ESA

N88-29549# Royal Signals and Radar Establishment, Malvern (England).
A THEORETICAL AND EXPERIMENTAL INVESTIGATION INTO THE USE OF SAW WEIGHTING TECHNIQUES IN OPTICAL DIFFRACTION GRATINGS
M. E. Lewis and C. L. West Mar. 1988 40 p
(RSRE-Memo-4128; BR106572; ETN-88-93131) Copyright
Avail: NTIS HC A03/MF A01

The behavior of optical diffraction gratings weighted in various ways analogous to those used in surface acoustic wave (SAW) devices is described. Apodization, withdrawal weighting, and chirp weighting techniques to generalize the sinc-function response of a grating are considered. It is shown that a wide variety of two dimensional responses can be achieved by these means. For quasi-rectangular responses, factors that limit the performance achievable in practice are detailed. Applications of these techniques in the spatial, temporal, and spectral domains are mentioned. ESA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-29550# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
DENSITY FLUCTUATIONS IN CURRENTLESS HIGH BETA PLASMAS IN HELIOTRON E
H. Zushi, O. Motojima, and M. Wakatani Oct. 1986 53 p
(DE88-752310; PPLK-R-13) Avail: NTIS (US Sales Only) HC A04/MF A01

The stability properties of currentless high beta plasmas were investigated over a wide range of density profiles, n sub e (r), by varying the gas puffing conditions and by pellet injection. Line density fluctuations correlated with a pressure-driven MHD instability were measured by a multi-channel far infrared laser interferometer. When an increase in the plasma beta was accompanied by peaking of n sub e (r), line density fluctuations with a frequency of 2 to 5 kHz periodically appeared. The repetition time of the fluctuations was typically 2 to 5 ms. The poloidal and toroidal mode numbers of fluctuations were identified as m = 1 and n = 1, respectively. For plasmas with an extremely peaked profile, density fluctuations corresponding to the m = 3/n = 2 mode were observed. After the latter modes grows, internal disruption occurs. Because of this disruption, n sub e (r) rapidly changes from a peaked profile to a broader one. The normalized average radius, r/a, of phase reversal in the density profile variation caused by the disruption is about 0.5, which roughly corresponds to the iota = 2/3 surface, where iota is the rationalized rotational transform. Mode coupling between m = 3/n = 2 and m = 1/n = 1 is the most plausible candidate for triggering the internal disruption. Finally, the onset regions for MHD instability are summarized for various density profiles and values. DOE

N88-29551 Boston Coll., Chestnut Hill, Mass.
WAVES AND INSTABILITIES IN AN ELECTRON-POSITRON PLASMA IN AN ULTRA-STRONG MAGNETIC FIELD Ph.D. Thesis
Peter Emery Pulsifer 1987 403 p
Avail: Univ. Microfilms Order No. DA8801071

Magnetic fields of up to 10 x 13 Gauss were observed in pulsars. At these ultrastrong fields, the energy between Landau levels is comparable to the electron rest-mass, and the cyclotron radius is comparable to the Compton wavelength. To study the electromagnetic properties of an electron or positron gas in such ultrastrong fields, the polarization tensor Pi sub mu nu is calculated. This response function is simply related to other functions like the dielectric and diamagnetic tensors. A dispersion relation is found involving Pi sub mu nu, whose solution determines the frequency-wavenumber relation for propagating electromagnetic waves in the system. A relativistic quantum-kinetic (Wigner function) technique is used. The quantum analog to the Vlasov equation is derived and linearized about a zero-temperature Fermi equilibrium, and approximation scheme equivalent to the random-phase-approximation (RPA). An integral equation is found for the four-current, which then determines the polarization tensor. The resulting dispersion is evaluated for propagation parallel to the magnetic field. Wave propagation and damping are analyzed in terms of two-body processes. Cutoffs and discontinuities in phase velocities of waves are noted and discussed in terms of the different processes. Properties of these solutions are discussed, and comparisons are made with earlier investigations in the appropriate limits. A detailed review of the parameter regime and method is presented. Dissert. Abstr.

N88-29552# Lawrence Livermore National Lab., Calif.
A SURVEY OF THE CURRENT EXPERIMENTAL DATABASE FOR LOWER HYBRID CURRENT-DRIVE AND HEATING
D. T. Blackfield 10 Feb. 1988 65 p Presented at the ITER Physics Meeting, Oak Ridge, Tenn., 10 Mar. 1988
(Contract W-7405-eng-48)
(DE88-009830; UCRL-98391-Rev-1; CONF-880397-1-Rev-1)
Avail: NTIS HC A04/MF A01

The proposed ITER design may rely heavily on Lower Hybrid waves to provide heating, current drive, MHD stabilization through current profile modification and transformer recharging. This paper presents a detailed survey of recent LH experimental results from PLT, Alcator C, ASDEX, Petula-B, FT and JT-60. Current drive and heating efficiencies are given, as well as regimes where sawteeth and m = 1 and 2 oscillations are stabilized. In addition, in ASDEX and JT-60, LH waves in combination with neutral beams, (a possible ITER scenario) experiments are examined. Finally, the current drive efficiency for ITER is obtained by extrapolating from the LHCD database. Assuming 12 MW of LH power, approximately 4.5 to 5.6 MA of current could be driven in ITER. However, the high density (ovr n sub e = 8 times 10 to the 19th power m sup 3 -3) and high temperature (ovr T sub e = 21 keV) will preclude wave penetration to the center. Assuming a narrow N sub parallel spectrum (1.2 approx. less than N sub parallel approx. less than 2) the LH waves should be absorbed within the outer half of the plasma. DOE

N88-29553# California Univ., Berkeley. Coll. of Engineering.
VORTEX FORMATION AND PARTICLE TRANSPORT IN A CROSS-FIELD PLASMA SHEATH
K. Theilhaber 20 Mar. 1988 100 p
(Contract DE-FG03-86ER-53220)
(DE88-008931; UCB/ERL-M-88/21) Avail: NTIS HC A05/MF A01

The time-dependent behavior of a transversely magnetized, two-dimensional plasma-wall sheath has been studied through particle simulations, with the aim of modelling plasma behavior in the vicinity of the limiters and walls of magnetized plasma-devices. The simulations have shown that the cross-field sheath between a wall and a plasma is a turbulent boundary layer, with strong potential fluctuations and anomalous particle transport. The driving mechanism for this turbulence in the Kelvin-Helmholtz instability, which arises from the sheared particle drifts created near the wall. Provided it is replenished by an internal flux of particles, the sheath maintains itself in a dynamic equilibrium, in which the linear edge instability, the nonlinear dynamics of the particles and the outward particle diffusion all balance each other. The sheath assumes an equilibrium thickness of order 1(sub x) (approximately) 5 (rho)(sub i), and maintains large, long-lived vortices, with amplitudes delta(phi) (approximately) 2T(sub i)e, which drift parallel to the wall at roughly half the ion thermal velocity. The sheath also maintains a large, spatially-averaged potential drop from the wall to the plasma, with lambda(phi) approx. (minus)1.5T(sub i)e, in sharp distinction with the unmagnetized sheath, where the plasma potential is higher than at the wall. Accompanying the long-wavelength vortices is a spectrum of shorter-wavelength fluctuations, which extend to (vert bar(K)vert bar)(rho)(sub i) (approximately) 1 and omega (approximately) omega (sub ci), and which induce an anomalous cross-field transport. A central result is that the anomalous transport scales like Bohm diffusion, at least when omega (sub pi) greater than or equal to 2 omega (sub ci). At lower densities, omega (sub pi) less than 2 omega (sub ci), the diffusion coefficient has an additional factor, proportional to the density. DOE

N88-29554# Los Alamos National Lab., N. Mex.
FUSION PRODUCT SPECTRA
T. L. Talley and G. M. Hale 1988 5 p Presented at the International Conference on Nuclear Data for Science and Technology, Mito, Japan, 30 May 1988
(Contract W-7405-eng-36)
(DE88-010912; LA-UR-88-1643; CONF-880546-9) Avail: NTIS HC A02/MF A01

Accurate fusion product data is required for most fusion plasma simulations. The energy broadening of reaction products is demonstrated to be more complicated than the usual Gaussian broadening. The accurate integrals are performed to obtain averaged E(sub incoming), sigma v, and dN/dE for all binary reactions in the four- and five-nucleon systems. Reaction cross sections were developed using R-Matrix models that include most recent measurements. DOE

N88-29555# Mission Research Corp., Albuquerque, N. Mex.
PLASMOID PROPAGATION Final Report, Nov. 1984 - Oct. 1986
Gerald F. Kiuttu, Richard J. Adler, Robert J. Richter-Sand, and Michael K. Williams 12 Feb. 1988 73 p Prepared in cooperation with North Star Research Corp., Albuquerque, N. Mex.
(Contract F49620-85-C-0022)
(AD-A192378; MRC/ABQ-R-1039; AFOSR-88-0382TR) Avail: NTIS HC A04/MF A01 CSCL 20I

Simple analytical considerations suggest that for certain parameter regimes for costreaming ion and electron beams, radial equilibrium can be expected without charge or current neutrality. To investigate these predictions experimentally, a pulsed power system comprising separate anode and cathode pulsers was designed and assembled. A double diode was developed to produce the plasmoids, and its steady-state space charge limited current researched over modest distances in terms of net current transport, radial profile, and beam front velocity. The results described in this report include the analysis and methodology leading to the successful production of nonneutral plasmoids and their propagation over distances up to several drift tube radii at currents more than an order of magnitude larger than predicted for either electron or ion constituents separately. GRA

N88-29556# Naval Surface Warfare Center, Silver Spring, Md.
NONLINEAR ANALYSIS OF NON-NEUTRAL PLASMAS Report, 1 Oct. 1986 - 30 Sep. 1987
V. M. Ayres 30 Sep. 1987 35 p
(AD-A192506; NSWC-TR-87-340) Avail: NTIS HC A03/MF A01 CSCL 20I

The purpose of this investigation is to incorporate nonlinear effects into the analysis of non-neutral plasma beams in order to accurately estimate their performance in realistic situations. Intense non-neutral plasma beams have important applications for DEW, SDI, high power microwave/millimeter wave production and particle beam guidance systems. GRA

N88-29557# Naval Research Lab., Washington, D.C.
KINETIC THEORY FOR ELECTROSTATIC WAVES DUE TO TRANSVERSE VELOCITY SHEARS Interim Report
G. Ganguli, Y. C. Lee, and P. J. Palmadesso 22 Feb. 1988 67 p
(AD-A193404; NRL-MR-6135) Avail: NTIS HC A04/MF A01 CSCL 20I

Shear in the flow velocity of a fluid leads to the low frequency and long wavelength Kelvin-Helmholtz (K-H) instability. The velocity shear can be generated in a number of ways. In a plasma the existence of an inhomogeneous electric field component transverse to the ambient uniform magnetic field can provide a transverse velocity shear. The evolution of the K-H instability in this configuration has been extensively studied. Recently some space observations and laboratory experiments seem to indicate that ion-cyclotron-like waves are observed for subcritical field aligned currents and therefore the origin of these waves is mysterious. A crucial feature of these observations and experiments was the presence of a transverse component of a zero order electric field. In order to study the role of the transverse electric fields in the generation of the ion-cyclotron-like waves, we suggested a mechanism based on the coupling of the negative energy ion Bernstein modes (or the ion cyclotron modes) in the region where the dc electric field is localized, with the positive energy ion Bernstein modes (or the cyclotron modes) in the region where the dc electric field is absent. Here we use kinetic theory to obtain the general dispersion relation rigorously, for the electrostatic oscillations in a plasma, in the form of an integral equation for an arbitrary electric profile. GRA

N88-29558# California Univ., Berkeley. Lawrence Berkeley Lab.
MEASUREMENTS OF VACUUM ARC ION CHARGE STATE DISTRIBUTIONS
I. G. Brown and J. E. Galvin Feb. 1988 9 p Presented at the 13th International Symposium on Discharges and Electrical

Insulation in Vacuum, Paris, France, 27 Jun. 1988
(Contract DE-AC03-76SF-00098)
(DE88-008249; LBL-24068; CONF-880687-5) Avail: NTIS HC A02/MF A01

The charge state distribution of ions generated in the metal vapor vacuum arc has been measured under a wide range of experimental conditions. The experiments were carried out using an ion source in which the metal vapor vacuum arc is used as the method of plasma production and by which a high quality, high current beam of metal ions is produced. Charge state spectra were measured using a time-of-flight diagnostic; arc voltages were also measured. Parameters varied include: cathode material, arc current, axial magnetic field strength, neutral gas pressure, and arc geometry. DOE

N88-29559# Wisconsin Univ., Madison.
NUMERICAL SIMULATIONS OF RESISTIVE MAGNETOHYDRODYNAMIC INSTABILITIES IN A POLOIDAL DIVERTOR TOKAMAK Ph.D. Thesis
E. Uchimoto Mar. 1988 109 p
(Contract DE-FG02-86ER-53218)
(DE88-010768; DOE/ER-53218/120) Avail: NTIS HC A06/MF A01

A new 3-D resistive MHD initial value code RPD has been successfully developed from scratch to study the linear and nonlinear evolution of long wavelength resistive MHD instabilities in a square cross-section tokamak with or without a poloidal divertor. The code numerically advances the full set of compressible resistive MHD equations in a toroidal geometry, with an important option of permitting the divertor separatrix and the region outside it to be in the computational domain. A severe temporal step size restriction for numerical stability imposed by the fast compressional waves was removed by developing and implementing a new, efficient semi-implicit scheme extending one first proposed by Harned and Kerner. As a result, the code typically runs faster than that with a mostly explicit scheme by a factor of about the aspect ratio. The equilibrium input for RPD is generated by a new 2-D code EQPD that is based on the Chodura-Schluter method. The RPD code, as well as the new semi-implicit scheme, has passed very extensive numerical tests in both divertor and divertorless geometries. Linear and nonlinear simulations in a divertorless geometry have reproduced the standard, previously known results. In a geometry with a four-node divertor the $m = 2$, $n = 1$ (2/1) tearing mode tends to be linearly stabilized as the $q = 2$ surface approaches the divertor separatrix. However, the $m = 1$, $n = 1$ (1/1) resistive kink mode remains relatively unaffected by the nearness of the $q = 1$ surface to the divertor separatrix. When plasma current is added to the region outside the divertor separatrix, the 2/1 tearing mode is linearly stabilized not by this current, but by the profile modifications induced near the $q = 2$ surface and the divertor separatrix. A similar stabilization effect is seen for the 1/1 resistive kink mode, but to a lesser extent. DOE

N88-29560# Los Alamos National Lab., N. Mex.
INTRODUCTION TO LASER PLASMA DIAGNOSTICS
A. A. Hauer and H. A. Baldis Apr. 1988 45 p
(Contract W-7405-eng-36)
(DE88-011056; LA-11178-MS) Avail: NTIS HC A03/MF A01

This report reviews optical and X-ray techniques for the diagnosis of laser-produced plasmas. Emphasis is placed on the parameter regimes (e.g., laser irradiance greater than 10 to the 12th power watts/sq cm) appropriate to the laser fusion field. We also include, however, material related to other laser-plasma work such as chemical analysis. This work is intended to be an introduction to the basic physical principles involved in measurements. We also deal with the comparison of these measurements with modeling. A considerable number of specific examples of measurements are presented to illustrate the techniques described. DOE

N88-29561# Argonne National Lab., Ill. Fusion Power Program.
BOOTSTRAP CURRENTS IN RADIO-FREQUENCY-DRIVEN TOKAMAK EQUILIBRIA
Ming-Yuan Hsiao, D. A. Ehst, and K. Evans, Jr. May 1988 36 p
(Contract W-31-109-eng-38)
(DE88-011136; ANL/FPP/TM-221) Avail: NTIS HC A03/MF A01

Interest in the bootstrap current arising from neoclassical transport in tokamaks has increased recently in view of certain experimental observations. In this study, the bootstrap current is calculated for a number of RF current-driven tokamaks. Two-dimensional, self-consistent, steady-state tokamak MHD equilibria are obtained by including both the transport-driven bootstrap current and the externally driven RF current. The self-consistency is accomplished by iterating between two-dimensional MHD equilibrium calculations and the current calculations (including bootstrap and RF ray-tracing). Calculations for other reactor parameters of interest are also carried out. It is found that for reactor-grade plasmas, the bootstrap current contribution to the toroidal current is, in general, important. An approximate scaling law for GAMMA, based on parametric survey performed, is also obtained. DOE

N88-29562# Oak Ridge National Lab., Tenn.
INITIAL OPERATION AND EDGE PLASMA STUDIES IN ATF (ADVANCED TOROIDAL FACILITY)
P. K. Mioduszewski, J. D. Bell, T. S. Bigelow, R. J. Colchin, E. C. Crume, J. L. Dunlap, G. R. Dyer, A. C. England, J. C. Glowienka, and J. W. Halliwell et al. 1988 17 p Presented at the 8th International Conference on Plasma Surface Interactions in Controlled Fusion Devices, Julich, Fed. Republic of Germany, 2 May 1988 Prepared in cooperation with Kyoto Univ., Japan
(Contract DE-AC05-84OR-21400)
(DE88-011400; CONF-880512-6) Avail: NTIS HC A03/MF A01

Initial plasmas have been obtained in the Advanced Toroidal Facility (ATF) at Oak Ridge. During the first operating period all major systems worked well. Currentless plasmas have been formed with electron-cyclotron heating (ECH) and neutral beam injection (NBI). Plasma breakdown is achieved with 200 kW of microwave power using the second harmonic of the 53 GHz gyrotron at 1 T. Because of the insufficient initial cleanup state of the vessel, the density evolution during the discharge is dominated by impurity influxes due to plasma-wall interactions. Wall conditioning has so far been performed with glow discharge and electron-cyclotron resonance discharge cleaning, with the walls at room temperature. Plasma edge studies are in preparation. They are focused on experiments leading to a divertor concept for ATF. During this brief operating period, plasma conditions were dominated by wall interactions. It is expected that during the next period additional wall conditioning techniques will lead to improved plasma performances. DOE

N88-29563# Academy of Sciences of the Ukrainian SSR, Kharkov.
APPARATUS FOR SUBMILLIMETER LASER DIAGNOSTICS OF HIGH-TEMPERATURE PLASMA
V. L. Berezhnyj, V. I. Kononenko, and O. S. Pavlichenko 1987 33 p In RUSSIAN; ENGLISH summary
(DE88-702464; KFTI-87-37) Avail: NTIS (US Sales Only) HC A03/MF A01

Constructions and characteristics of an HCN laser with RF discharge (RFD) and a CH3OH laser pumped with a CO2 laser radiation are presented. Scaling laws simplifying the RFD HCN design calculations with the given parameters are found. The CH3OH-laser frequency-response curve, that essentially determines the main heterodyne laser interferometer characteristics, is investigated. Owing to high stability of the output power and frequency the present lasers can be used in heterodyne interferometers. The design and parameters of a low temperature submillimeter radiation detectors on the basis of InSb and GeLi crystals are described. The results of interferometer measurements

at plasma devices by means of the given apparatus are presented. DOE

N88-29564# California Univ., Berkeley. Electronics Research Lab.
COLLECTOR AND SOURCE SHEATHS OF A FINITE ION TEMPERATURE PLASMA
L. A. Schwager and C. K. Birdsall 13 Apr. 1988 46 p
(Contract DE-FG03-86ER-53220)
(DE88-008934; UCB/ERL-M-88/23) Avail: NTIS HC A04/MF A01

The region between a Maxwellian plasma source and an absorbing surface is modeled with an electrostatic particle simulation and with a kinetic plasma-sheath model. In the kinetic model, Poisson's equation and Vlasov equations govern the velocity distribution of the ions and electrons. The numerical and theoretical results for collector potential and plasma transport agree with the bounded model of Emmert et al., but differ somewhat from those using traditional Bohm sheath analysis. The plasma source injects equal fluxes of half-Maxwellian ions and electrons with specified mass and temperature ratios and is assumed to have a zero electric field. Representing the potential change within a distributed full-Maxwellian source region, the source potential drop depends primarily on temperature ratio and evolves a few Debye lengths from the source to neutralize the injected plasma. The plasma flows to an electrically floating collector where the more familiar electron repelling collector sheath appears. Profiles of potential, density, drift velocity, temperature, kinetic energy flux, and heat flux are shown from simulation; all compare very well with theory. DOE

N88-29565# California Univ., Berkeley. Electronics Research Lab.
PLASMA THEORY AND SIMULATION Quarterly Progress Report, Nos. 1-2, 1 Jan. - 30 Jun. 1987
Charles K. Birdsall 1987 26 p
(Contracts DE-FG03-86ER-53220; N00014-85-K-0809)
(AD-A194674) Avail: NTIS HC A03/MF A01 CSCL 20I

Ion acceleration in the plasma source sheath, with an initial ion velocity, where it is found analytically that ions leave the source with drift velocity greater than the velocity of sound, obviating the need for pre-sheath acceleration in the bulk plasma preceding a collector sheath; and plasma wall physics -- theory and simulation are discussed. Abstracts are provided on: Collector and source sheaths of a finite ion temperature plasma; Effects of secondary electron emission on the collector and source sheaths of a finite ion temperature plasma; Effects of ion reflection on the collector and source sheaths of a finite ion temperature plasma; and Vortex dynamics and transport to the wall in a crossed field plasma sheath. GRA

N88-29566# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
TOKAMAK PLASMA INTERACTION WITH LIMITERS Ph.D. Thesis
Charles Spencer Pitcher Aug. 1988 321 p
(UTIAS-325; ISSN-0082-5255) Copyright Avail: NTIS HC A14/MF A01

The importance of plasma purity is discussed in terms of the general requirements of controlled thermonuclear fusion. The tokamak approach to fusion and its inherent problem of plasma contamination are introduced. A main source of impurities is due to the bombardment of the limiter by energetic particles and thus the three main aspects of the plasma-limiter interaction are reviewed, boundary plasma conditions, fueling/recycling and impurity production. The experiments, carried out on the DITE tokomak at Culham Laboratory, UK, investigated these three topics and the results are compared with predicted behavior; new physical phenomena are presented in all three areas. Author

N88-29567# Berkeley Research Associates, Inc., Calif.
MODELING OF ATOMIC PROCESSES IN X-RAY LASER PLASMAS Final Report, 19 Sep. 1986 - 19 Sep. 1987
Mar. 1988 27 p
(Contract N00014-86-C-2454)
(AD-A194118; BRA-88-W030R) Avail: NTIS HC A03/MF A01 CSCL 20E

It is demonstrated that the linear response scheme within the framework of density functional method can provide reliable atomic data for various atoms and ions of experimental interest. This model is particularly useful in those situations where conventional independent particle models fail to generate accurate data. The atomic structure code for multielectron ions of arbitrary Z is of central importance in these calculations. Proper relativistic treatment is included in our work for high Z ions. The mechanism of time-dependent polarization of the atom is seen to be important in describing the experimental observations. For most experimental situations, the present method is adequate and very useful. If the applied radiation field strength is very high, suitable generalization of the present model or development of new techniques are necessary to treat those conditions. GRA

N88-29568# Loughborough Univ. of Technology (England). Dept. of Mathematics.
THE CALCULATION OF TIME DEPENDENT EDDY CURRENTS IN TOKAMAKS
G. A. Evans and R. Smith Feb. 1988 11 p
(Rept-206; ETN-88-92834) Avail: NTIS HC A03/MF A01

Large eddy currents due to plasma disruption in a fusion reactor tokamak were calculated using a finite difference approach to the T-Omega formulation. The program uses a data structure to allow for variable grid sizes and unusual boundary shapes. Linear and exponential plasma disruptions are considered. ESA

N88-29569# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
PLASMA TORCH DESIGN CODES PACKAGE
S. Muller 1987 5 p Presented at the ISPC-8 Conference, Tokyo, Japan, 1987
(SNIAS-881-430-115; ETN-88-92863) Avail: NTIS HC A02/MF A01

A set of codes to dimension plasma torches made up of 2 coaxial cylindrical electrodes cooled-up in the 100 kW to 100 MW power range is described. Its basis is a modeling code of exchanges between a gas and an electric arc in a cylindrical channel which uses the thermodynamic properties and the transport coefficients of the gas in a wide range. For the air, these properties were established taking into account the existence of 28 species in the gas. This code supplies a data bank that indexes each calculation case. An experimental data bank has the characteristics and performances of plasma torches and of the different operating points. Both data banks establish the operating chart of a given dimension plasma torch to find the electrical and air supply. A modeling code of convective transport between the wall and the cooling water together with the knowledge of the wall heat flux suggests the characteristics of cooling water supply. A mechanical and heat code dimension the electrodes or the plasma producing channel. A magnetic field code calculates the necessary field coil to make the arc root rotating and ensure the lifetime of the electrodes. ESA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-29570# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INFLUENCE OF PAIRING CORRELATIONS ON THE PROBABILITY AND DYNAMICS OF TUNNELING THROUGH THE BARRIER IN FISSION AND FUSION OF COMPLEX NUCLEI
Yu. A. Lazarev 1986 24 p Submitted for publication

(DE88-701500; JINR-E-4-86-577) Avail: NTIS (US Sales Only) HC A03/MF A01

An analytically solvable model is used to study the potential barrier penetrability in the case when the gap parameter lambda is treated as a dynamical variable governed by the least action principle. It is found that, as compared to the standard (BCS) approach, the dynamical treatment of pairing results in a considerably weakened dependence of the fission barrier penetrability on the intensity of paring correlations in the initial state (delta sub O), on the barrier height, and on the energy of the initial state. On this basis, a more adequate explanation is proposed for typical order-of-magnitude values of the empirical hindrance factors for ground-state spontaneous fission of odd nuclei. It is also shown that a large enhancement of superfluidity in tunneling (the inherent effect of the dynamical treatment of pairing) strongly facilitates deeply subbarrier fusion of complex nuclei. Finally, an analysis is given for the probability of spontaneous fission from K-isomeric quasiparticle (q-p) states in even-even heavy nuclei. The relative change of the partial spontaneous fission half-life in going from the ground-stste to a high-spin q-p iosmeric state, T(sub sf)/T(sub sf), is found to be strongly dependent on whether of not there takes place the dynamically induced enhancement of superfluidity in tunneling. Measurements of T(sub sf)/T(sub sf) thus provide a unique possibility of verifying theoretical predictions about the strong, inverse-square lambda dependence of the effective inertia associated with large-scale subbarrier rearrangements of nuclei. DOE

N88-29571# California Univ., Berkeley. Lawrence Berkeley Lab.

POTENTIAL INDUCED STRUCTURAL TRANSFORMATIONS OF THE Au(100) AND Au(111) SURFACES

P. N. Ross, Jr. Dec. 1987 7 p Presented at the Electrochemical Society Spring Meeting, Atlanta, Ga., 15 May 1988
(Contract DE-AC03-76SF-00098)
(DE88-005446; LBL-24442; CONF-880549-1) Avail: NTIS HC A02/MF A01

Work has concentrated on the use of emersed Au(111) films evaporated on cleaved mica, analogous to the Ag(111) films used in other GID studies. We have studied these Au(111) films using the dame LEEDUHV apparatus as in our previous studies of Au(111) crystals, and supplemented these with GID (grazing incidence X-ray diffraction) analysis of emersed Au(111) films with thru-air transfer to a two-circle diffractometer on beamline VI at SSRL. In-situ studies using GID with a new four-circle diffractometer on beamline VI at SSRL are scheduled for the spring running of SSRL. The ex-situ analyses by LEED and GID of the (1 x 1) yields (5 x 20) transformation were in reasonable agreement with one another, and the results qualitatively similar to the results for Au(100), i.e., the reconstructed (square root of 3 x 22) surface was observed only with emersion from K+ and Cs+ electrolytes, and not from pure acids, but the (square root of 3 x 22) was observed at much more anodic potentials of emersion than for the (100)-(5 x 20). Both of the reconstructions on Au(111) and (100) represent a contraction of the Au-Au bond length for the Au-Au bond length for the Au atoms in surface layer, 4 and 6.5 percent. Anions on the emersed surface stabilize the (1 x 1) structure and possibly cause an as yet unobserved expansion in the Au-Au surface atom bond length. Charge density waves (solitons) produced by ion (cation or anion) adsorption appear to be the driving force for the (111)-(1 x 1) reversible reaction beginning at the left (square root of 3 x 22) and (100)-(1 x 1) reversible reaction beginning at the left (5 x 20) surface phase transitions. DOE

N88-29572# Brookhaven National Lab., Upton, N. Y.

EFFECTS OF METAL SUBSTITUTIONS (Fe AND Ga) IN YBa2Cu3O7 ON ITS SUPERCONDUCTING PROPERTIES AND MICROSTRUCTURES

Youwen Xu, A. R. Moodenbaugh, R. L. Sabatini, and M. Suenaga 1988 3 p Presented at the Spring Meeting of the Materials Research Society, Reno, Nev., 4 Apr. 1988
(Contract DE-AC02-76CH-00016)
(DE88-007393; BNL-40934; CONF-880408-4) Avail: NTIS HC A02

A systematic microstructural study of YBa2Cu3O7 as functions of the amounts of the replacement elements, Fe and Ga, was undertaken. A series of YBa2(Cu(sub 1-x)M(sub x)3) O7 where M = Fe or Ga and x less than or equal to 0.1 were prepared using a standard powder-sintering technique, and these specimens were characterized using X-ray powder diffractometry, resistive and inductive techniques for determining T(sub c), and transmission electron microscopy. Results from the Fe-containing series are nearly complete. Preliminary data only is available for the Ga-containing case. Results of the measurements, T(sub c)(inductive), the resistivity rho (300 K), the rate of drop in rho, (d rho/dt) and the lattice parameters are listed. DOE

N88-29573# International Centre for Theoretical Physics, Trieste (Italy).

LOCAL ENVIRONMENT APPROACH FOR DEEP-LEVEL DEFECTS IN SEMICONDUCTORS: APPLICATION TO THE VACANCY IN SILICON

Yongliang Wang and U. Lindefelt Apr. 1987 39 p
(DE88-702017; IC-87/33) Avail: NTIS (US Sales Only) HC A03/MF A01

A local environment approach for calculation of the electronic structure of localized defects in semiconductors is described. The method starts from a description of localized orbitals or tight-binding model for semiconductors and is based on the recursion method of Haydock. A repeated symmetrical supercell containing 686 atoms plus defects is formed; both the translational and point-group symmetry of the crystal are fully exploited. In this paper, we report an application of this approach to an undistorted isolated vacancy by using a self-consistent Hamiltonian. A bound state of T sub 2 symmetry at 0.87 eV above the valence-band edge and a number of band resonances within the valence-band were extracted using Lanczos algorithm and a continued-fraction representation of the local density of states. It was found that the T sub 2 symmetry gap state is mainly p-like and most of the wavefunction for one of the A sub 1 symmetry resonances is concentrated on the vacant site and another concentrated on the first neighbors of the vacancy. From the small shifts of the band edges of silicon with a vacancy, we can conclude that the supercell is big enough and the interaction between the defects of different supercells is negligible. DOE

N88-29574# International Centre for Theoretical Physics, Trieste (Italy).

PROPERTIES OF STRONG COUPLED SUPERCONDUCTORS

L. N. Bulaevskii, O. V. Dolgov, and M. O. Ptitsyn Jul. 1987 16 p
(DE88-702050; IC-87/163) Avail: NTIS (US Sales Only) HC A03/MF A01

By use of Eliashberg equations the system of electrons and phonons with the Einstein spectrum alpha (sub 2) (omega) F(omega) = lambda x omega/2 delta (omega - OMEGA) is studied. The orbital and paramagnetic upper critical magnetic fields are obtained in the case of strong electron-phonon coupling lambda including lambda is much greater than 1. For lambda much greater than 1 superconducting parameters at very low temperatures differ remarkably from that near T(sub c), the crossover takes place at a temperature corresponding to the phonon frequency omega. For lambda is greater than or approximately 4 at temperatures below about omega/3 the superconducting correlation length decreases giving the positive curvature in the temperature dependence of upper critical field. The obtained results favor the ratio delta(O)/T (sub c) to be proportional to the square root of lambda at lambda is greater than or approximately 4/6. The coefficients of GL functional are calculated. The absolute value of specific heat jump grows with lambda while its relative value drops. At lambda is greater than or approximately 4 the resistivity above T(sub c) increases linearly with temperature. DOE

N88-29575 Michigan Univ., Ann Arbor.

STUDIES ON STRAINED (In,Ga)As/GaAs SEMICONDUCTORS

AND OPTICAL DEVICES Ph.D. Thesis
Utpal Das 1987 183 p
Avail: Univ. Microfilms Order No. DA8801306

A detailed study of strained single and multilayered In-containing III-V compounds grown by molecular beam epitaxy, their characterization and determination of some important properties of guided wave devices and photodiodes in the 1 to 1.55 micron wavelength range using these materials is presented. The refractive index step of In(x)Ga(1-x)As/GaAs heterojunctions, necessary for optical confinement and guided wave applications, is calculated from the shifts in the bandgaps due to alloying and strain effects. Defects in GaAs isoelectronically doped with In were studied. Deep-level densities and the densities of defects observed in the photoluminescence spectra are found to decrease with the incorporation of small amounts of In. InGaAs/GaAs strained layer superlattices (SLS) and multiple quantum wells (MQW) were studied for their use in optical and opto-electronic devices. Deep level traps in as-grown and Si-implanted and lamp annealed InGaAs/GaAs SLSs were characterized. The performance of photodectors made with the strained materials were studied. Finally p-i-n electroabsorption modulators using SLS i-regions were integrated with low-loss GaAs:In waveguides. The integrated structures are realized by molecular-beam epitaxial regrowth. A 20 percent modulation depth at 1.15 micrometers is measured with an integrated In(0.34)Ga(0.66)As (100 A)/GaAs (150 A) modulator at room temperature. Dissert. Abstr.

N88-29576# International Centre for Theoretical Physics, Trieste (Italy).
POSSIBLE MECHANISM FOR HIGH-TEMPERATURE SUPERCONDUCTIVITY IN THE BaSr-La(Y)-CuO SYSTEMS
M. Apostol Jul. 1987 11 p
(DE88-702060; IC-87/174) Avail: NTIS (US Sales Only) HC A03/MF A01

A high-temperature mechanism of superconductivity is proposed for distorted perovskite-like structures of Ba(x)La(2-x)CuO(4) type. For x close to unity it is shown that the Jahn-Teller effect of the Cu(sup 2+) cations might bring about an attractive pairing interaction in the wavevector space. In the opposite limit x is approximately 0 it is argued that the Coulomb repulsion might cause a real-space electron pairing. In both cases optimal values of the concentration x are predicted above 1-1/pi and below 1/pi which agree with the experimental data. The corresponding critical temperatures are also estimated. DOE

N88-29577# Brown Univ., Providence, R. I. Div. of Engineering.
SHEAR STRESS AT A FILM-SUBSTRATE INTERFACE DUE TO MISMATCH STRAIN
L. B. Freund and Y. Hu Jan. 1988 35 p
(Contract N00014-87-K-0481)
(AD-A193461) Avail: NTIS HC A03/MF A01 CSCL 20L

The elastic stress distributions that develop when a thin film of one material is bonded to a half space of a second material under conditions with a mismatch strain that results in a state of residual stress. The origin of the mismatch strain may be temperature change, chemical reaction, remote applied loading on the substrate, or some other source. The distribution of shear stress at the interface is determined for the case when the film is thin enough to be idealized as a membrane. A semi-infinite film is considered first to examine in detail the concentration of shear stress near the edge. Then, a periodic array of film segments is considered, and the dependence of the stress distribution and the stress concentration factor on spacing and material parameters is determined. The special case of an isolated film segment is studied by taking the spacing distance to be very large compared to the segment width. All problems are cast in the form of a singular integral equation for the distribution of shear stress at the interface, and this integral equation is solved numerically for the cases of interest. Representative results are also presented for the distribution of mean stress and resolved shear stress in the substrate due to the mismatch strain. Finally, the limitations of the film idealization of the substrate are discussed. GRA

N88-29578# Sandia National Labs., Albuquerque, N. Mex.
La2CuO(SUB 4 + DELTA): A SUPERCONDUCTING SUPEROXIDE
J. E. Schirber, B. Morosin, E. L. Venturini, N. D. Shinn, J. W. Rogers, Jr., and D. S. Ginley 1988 4 p Presented at the 10th Annual Ideas in Science and Electronics Exposition, Albuquerque, N. Mex., 10 May 1988
(Contract DE-AC04-76DP-00789)
(DE88-010325; SAND-88-1197C; CONF-880579-6) Avail: NTIS HC A02/MF A01

High pressure high temperature oxygen treatment results in changing antiferromagnetic La2CuO(sub 4) into a bulk superconductor La2CuO(sub 4.13). Evidence demonstrating that the excess oxygen is incorporated as the superoxide, is discharged. DOE

N88-29579# Lawrence Livermore National Lab., Calif.
SHORT PULSE X-RAY DIFFRACTION STUDIES OF SHOCKED AND ANNEALED CRYSTALS USING THE JANUS RESEARCH LASER
R. W. Lee, M. J. Eckart, J. D. Kilkenny, R. R. Whitlock, A. Hauer, and J. S. Wark 1987 15 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987 Prepared in cooperation with NRL, Washington, D.C., Los Alamos National Lab., N. Mex. and Rochester Univ., N.Y.
(Contract W-7405-eng-48)
(DE88-011329; UCRL-97218; CONF-8708110-38) Avail: NTIS HC A03

When a crystal is annealed or shocked the spacing of the interatomic planes is altered, and a measurement of the lattice spacing can yield information on the temperature or compression respectively. We have used the JANUS research laser at LLNL to perform such measurements of transiently strained crystals. JANUS is a two-beam laser system, with separate synchronized oscillators for each beam. One beam of the laser, containing 10 to 100 J of 1.06 micron light in a pulse of 1 ns FWHM, was found to a 3.9 cm diameter spot on the surface of silicon crystal; the crystal was either annealed or shock-compressed, depending on the absence or presence of a variety of thin coatings applied to the crystal surface. At some time during or after the perturbing pulse, the second synchronous but delayed laser beam, containing approximately 10 J of 0.53 micron light in a pulse of 100 ps (FWHM), was focused to a 40 micron diameter spot onto a separate target containing calcium, potassium, and chlorine. Thus, a short pulse of the helium-like line radiation of these atoms was produced, and this radiation was Bragg diffracted from the surface of the strained crystal. Measurements of the change in Bragg angle, caused by thermal expansion or shock compression, gives a direct measurement of one component of the strain within the crystal. A single laser shot gives recordable X-ray levels. A number of shots at different irradiances and delay times gave information about the lattice spacing as a function of time. The potential applications of such results is discussed. DOE

N88-29580# Los Alamos National Lab., N. Mex.
ELECTRON MICROSCOPY OF CERAMIC SUPERCONDUCTORS
T. E. Mitchell and T. Roy 1988 7 p Presented at the 4th Asia-Pacific Conference on Electron Microscopy, Bangkok, Thailand, 26 Jul. 1988
(Contract W-7405-eng-36)
(DE88-006446; LA-UR-88-642; CONF-880737-1) Avail: NTIS HC A02/MF A01

The critical current Jc is at least as important as Tc (transition temperature) for applications in superconducting materials. Jc is strongly dependent on microstructure and, in consequence, electron microscopy will continue to be important in the development of practical ceramic superconductors. We will review the progress that has been made over the past year or so in studying the superconductors by electron microscopy techniques

of all kinds of conventional, high resolution, analytical, etc. A thorough review is impossible but a bibliography is available, as well as two special issues of Journals. DOE

N88-29581# California Univ., Berkeley. Lawrence Berkeley Lab.
HIGH-T(SUB c) SUPERCONDUCTOR AND ITS USE IN SUPERCONDUCTING MAGNETS
M. A. Green Feb. 1988 69 p
(Contract DE-AC03-76SF-00098)
(DE88-008403; LBL-23946) Avail: NTIS HC A04/MF A01

Many of the proposed uses for the high-T(sub c) superconductor involve the creation of a magnetic field using superconducting coils. This report will assess what is known about the high-T(sub c) superconductors and take a realistic look at their potential use in various kinds of superconducting magnets. Based on what is known about the high-T(sub c) superconductors, one can make a wish list of things that will make such materials useful for magnets. Then, the following question is asked: if one had a high-T(sub c) superconductor with the same properties as modern niobium-titanium superconductor, how would the superconductor work in a magnet environment. Finally, this report will show the potential impact of the ideal high-T(sub c) superconductor on: (1) accelerator dipole and quadrupole magnets, (2) superconducting magnets for use in space, and (3) superconducting solenoids for magnetic resonance imaging. DOE

N88-29582# Missouri Univ., Columbia. Dept. of Physics and Astronomy.
INTRINSIC AND EXTRINSIC ENERGY STATES OF SEMICONDUCTORS AND HETEROSTRUCTURES USING NOVEL TECHNIQUES Final Report, 1 Dec. 1986 - 30 Mar. 1988
H. R. Chandrasekhar Apr. 1988 19 p
(Contract DE-AC02-84ER-45048)
(DE88-008560; DOE/ER-45048/1) Avail: NTIS HC A03/MF A01

We have succeeded in performing the first study of all the quantized levels in a GaAs--Ga(sub 1-x)Al(sub x)As multiple quantum well (MQW) structure using a combination of three novel experimental techniques: (1) photoreflectance spectroscopy which is sensitive to very small changes in optical constants due to its derivative nature, (2) application of large hydrostatic pressures using a diamond anvil cell. The conduction band extrema at different points in the momentum space of a semiconductor can be drastically altered by the application of large pressures. This enables one to study the states associated with high energy bands, (3) the ability to perform (1) and (2) as a function of temperature has enabled us to identify features which are highly sensitive to temperatures. The new and interesting results that have emerged are: (1) accurate temperature and pressure coefficients of a large number of MQW levels, (2) quantitative information of the carrier confinement and its dependence on various band structure parameters, (2) the pressure coefficients associated with the higher bands along the L and X. We have also simultaneously performed the photoluminescence studies under pressure at cryogenic temperatures. The important implications of these results in understanding the nature of deep levels in bulk semiconductors and heterostructures is discussed. DOE

N88-29583# Argonne National Lab., Ill.
PREPARATION OF SUPERCONDUCTING YBa2Cu3O(SUB 7-x) FILMS BY MAGNETRON SPUTTERING
J. H. Kang, R. T. Kampwirth, K. E. Gray, A. Wagner, and E. A. Huff Feb. 1988 3 p Presented at the Spring Meeting of the Materials Research Society, Reno, Nev., 4 Apr. 1988
(Contract W-31-109-eng-38)
(DE88-009977; CONF-880408-22; CONF-880408) Avail: NTIS HC A02/MF A01

We have prepared thin films of YBa2Cu3O(sub 7-x) by dc-magnetron sputtering from three separate metallic targets onto ambient temperature substrates of (100)SrTiO3, (100) and random oriented ZrO2-9 percent Y2O3, and (100)MgO. After annealing, the films grown on SrTiO3 showed a mixture of a- and c- axis orientation while the films grown on ZrO2 and on MgO were randomly oriented. The targets used in sputtering were either yttrium, barium and copper or yttrium, Ba2Cu3 and copper. The latter combination offered better control of the film composition because the CuBa ratio could be more accurately maintained and the target itself was more stable. To check the reproducibility of film composition, an Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES) technique was employed to obtain average composition. Compositional variations in films produced under similar conditions are within 1 to 3 percent which was close to the instrumental resolution. DOE

N88-29584# Argonne National Lab., Ill.
AN HVEM STUDY OF DISPLACEMENT CASCADE DAMAGE IN Nb3Sn AT 13 K
M. A. Kirk, M. C. Baker, B. J. Kestel, H. W. Weber, and R. T. Kampwirth Feb. 1988 18 p Presented at the 14th International Symposium on Effects of Radiation on Materials, Andover, Mass., 27 Jun. 1988 Prepared in cooperation with Wisconsin Univ., Madison and Atominstitut der Oesterreichischen Univ., Vienna
(Contract W-31-109-eng-38)
(DE88-009997; CONF-880613-10) Avail: NTIS HC A03/MF A01

TEM images of the martensite structure in Nb3Sn were recorded at various temperatures between 12 and 30 K. The transition to the superconducting state was observed by a slight deflection of the electron beam due to a perturbation of the magnetic field of the objective lens at the sample. The primary interest is in irradiation effects due to fast neutrons from a fusion reactor, and therefore ion irradiation conditions that are somewhat comparable to this were selected. These consisted of 50 keV Xe(sup =) irradiations to simulate neutron produced cascades in a near surface region and 1.5 Mev Kr(sup +) to produce cascade damage through a greater sample thickness. Defect images were obtained as a function of ion dose at 13 K using both fundamental and superlattice dark-field reflections in two-beam conditions. For 50 keV Xe(sup +) irradiations at 13 K the defect yields were quite low at low ion doses where individual defect cascades are well separated. At higher ion doses when significant cascade overlap is present, defect density and contrast became greater than expected. Annealing to room temperature produced a large increase in defect density. Irradiation by 1.5 MeV Kr(sup +) at 15 K removed the martensite structure by an ion dose of 5 x 10 to the 12th/sq cm. Further irradiation to 3.5 x 10 to the 13th/sq cm produced evidence for the initial stage of amorphization. DOE

N88-29585# North Carolina State Univ., Raleigh. Dept. of Chemistry.
BAND ELECTRONIC STRUCTURES AND CRYSTAL PACKING FORCES Progress Report, 1 Jul. 1987 - 9 Feb. 1988
M. H. Whangbo Feb. 1988 8 p
(Contract DE-FG05-86ER-45259)
(DE88-010247; DOE/ER-45259/4) Avail: NTIS HC A02/MF A01

Progress has been made in several aspects of our research on organic conducting salts, high temperature inorganic superconductors, and other low-dimensional materials. Band electronic structure study on the new ambient-pressure superconductor (BEDT-TTF)2Cu(NCS)2 (T(sub c) = 10.4 K) revealed that this salt is a two-dimensional metal. The (BPDT-TTF)3(INI4)2 salt consists of BPDT-TTF molecules in two different oxidation states. Band electronic structure calculations on (2,5-DM-DCNQI)2Cu revealed that its metallic character must arise from the presence of copper atom mixed-valence (i.e., Cu(+) and Cu(2+). Band electronic structure calculations were performed to examine the difference between the orthorhombic and tetragonal phases of YBa2Cu3O(7-y). We developed empirical atom-atom potentials that reproduce the crystal structure of binary oxides BaO, CuO, La2O3, and Y2O3. On the basis of our band electronic and empirical atom-atom potential studies, we proposed that linear electron-hole-electron pairing in Cu(2+)-O-Cu(3+)-O-Cu(2+) units via concerted breathing-mode vibration is essential for the

high-temperature superconductivity in La(2-x)M(x)CuO4 and YBa2Cu3O(7-y). We also found that our empirical atom-atom potentials provide a reasonable set of IR and Raman frequencies for La(2-x)M(x)CuO4. DOE

N88-29586# Brookhaven National Lab., Upton, N. Y.
CONDUCTOR LOSS IN SUPERCONDUCTING POWER TRANSMISSION CABLES
E. B. Forsyth 1988 10 p Presented at the Conference on Superconductivity and Applications, Buffalo, N.Y., 18 Apr. 1988
(Contract DE-AC02-76CH-00016)
(DE88-011414; BNL-41289; CONF-880466-3) Avail: NTIS HC A02

An analytic solution for the hysteretic loss in a Type 2 superconductor has been derived which is analogous to hysteretic loss in ferromagnetic materials subjected to weak alternating fields. In practice the losses in a practical conductor design are increased above the intrinsic loss due to such effects are grain size, surface roughness and the addition of other metallic components. The choice of conductor configuration also affects the losses. Flexible conductors, for example, exhibit further loss mechanisms due to circulating currents and proximity effects. Quantitative results are compared with theory. DOE

N88-29587# Ohio Univ., Athens. Dept. of Physics and Astronomy.
ELECTRONIC STATES IN TUNNELING SEMICONDUCTOR SUPERLATTICES Technical Progress Report, 15 Sep. 1987 - 14 Sep. 1988
S. E. Ulloa 15 May 1988 14 p
(Contract DE-FG02-87ER-45334)
(DE88-011571; DOE/ER-45334/1) Avail: NTIS HC A03/MF A01

This research project funded by DOE has concentrated in the systematic study of the effects of a gate voltage on the electronic structure of a tunneling superlattice system. The effects of strong magnetic fields and other various parameters on energy levels of tunneling superlattices have been investigated. DOE

N88-29588# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
MAGNETIC PHASE TRANSITIONS IN 90-K SUPERCONDUCTORS Ho1Ba2Cu3O(7-DELTA) AND Gd1Ba2Cu3O(7-DELTA) OBSERVED BY ZF-MUON(+)SR
Nobuhiko Nishida, Hideaki Miyatake, Satoshi Okuma, Yoshitaka Kuno, Yasushi Watanabe, Toshimitsu Yamazaki, Shinobu Hikami, Masayasu Ishikawa, Toshiro Takabatake, and Yasuhiro Nakazawa et al. Oct. 1987 12 p
(DE88-752611; INS-653) Avail: NTIS (US Sales Only) HC A03/MF A01

Freezing of holmium magnetic moments was observed below 3 K in a 90-K superconductor Ho1Ba2Cu3(sub 7-delta) by zero-field positive muon spin relaxation (ZF-mu+ SR) measurements. The ZF-mu+SR function revealed a drastic change of mu+ local field from a critically fluctuating regime (4 to 7 K) to a quasi-static regime below 3 K (of nearly Gaussian distribution). The observation indicates that holmium magnetic moments are short-range ordered around 2 K. In contrast, a 90-K superconductor Gd1Ba2Cu3O(sub 7-delta) showed a zero-field spin precession at 2 K, indicating a long-range ordering of gadolinium magnetic moments. DOE

N88-29589# Japan Atomic Energy Research Inst., Tokyo. Dept. of Thermonuclear Fusion Research.
STABILITY EXPERIMENTAL RESULTS OF CABLE-IN-CONDUIT SUPERCONDUCTOR FOR FUSION
Eisuke Tada Jan. 1988 105 p In JAPANESE; ENGLISH summary
(DE88-753424; JAERI-M-87-214) Avail: NTIS (US Sales Only) HC A06/MF A01

In case of the forced-flow cooling, the design basis should be established regarding the stability, the static pressure drop and the transient pressure rise during quench which are more serious than that of the pool-boiling cooling coils by liquid helium. For this purpose, JAERI constructed a 15-kA cable-in-conduit conductor whose major parameters is based on a real conductor of FER and measured the stability, the pressure drop, and the pressure rise characteristics by using the Superconducting Engineering Test Facility (SETF). The following conclusions are obtained by this experiment in which a disturbance is applied to a part of the conductor by an inductive heater for a heating time duration of 6 msec. Two types of quench, which are quench at the heated zone and at the down stream region, are observed and the down stream quench is serious for the forced-flow cooling coils because the down stream quench is caused by a lesser disturbance than the heated zone. The heated zone conductor is cooled by a transient heat transfer and an induced flow which give a higher cooling capability than the steady flow in the down stream region. The calculated stability characteristics by an analysis code ALPHE-II are in good agreement with the measured value. The down stream quench is caused by hot helium flowing from the heated zone to the down stream and the stability margin measured is in good agreement with the calculated value by a simple energy balance based on the quasi-static process. The friction factor of a cable-in-conduit conductor has a smooth slope and is in good agreement with the equation for turbulent flow. In addition, the friction factor is roughly twice that of a smooth tube. The pressure rise obtained in a full quench condition is in good agreement with the calculated value by the ALPHE-II and linearly increases as the heating energy to the helium is increased. DOE

N88-29590# Santa Catarina Univ., Florianopolis (Brazil).
THERMODYNAMICAL, OPTICAL AND X-RAYS STUDIES OF SOME THERMOTROPIC LIQUID CRYSTALS M.S. Thesis
M. Porath 1986 82 p In PORTUGUESE; ENGLISH summary
(DE88-702301; INIS-BR-1037) Avail: NTIS HC A05/MF A01

The temperatures and enthalpies of transition were studied for the compound p-cyane metane-4 (trans 4'-n-pentylcyclohexyl) biphenyl as well as layer spacing (d) and intermolecular distance (as a function of temperature). These data together with the texture are used to identify the mesophase present. In compounds of the series p(4-n-alcoxybenzoiloxy) benzilidene 4'-n-decanoxyanaline temperature and enthalpies of transition were measured and textures observed. The intermolecular distance (D), layer spacing (d) as well as the indexes of refraction (all as a function of temperature) were also measured. The mesophases were identified based on these data. DOE

N88-29591# Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica.
RAPID THERMAL ANNEALING OF SILICON LAYERS AMORPHIZED BY ION IMPLANTATION Ph.D. Thesis
C. M. Hasenack 1986 113 p In PORTUGUESE; ENGLISH summary
(DE88-702307; INIS-BR-1043) Avail: NTIS HC A06/MF A01

The recrystallization behavior and the suppression mechanisms of the residual defects of silicon layers amorphized by ion implantation, were investigated. The samples were annealed with the aid of a rapid thermal annealing (RTA) system at temperature ranging from 850 to 1200 C, and annealing time up to 120 s. Random and aligned Rutherford backscattering spectroscopy were used to analyze the samples. Similarities in the recrystallization behavior for layers implanted with ions of the same chemical groups such as As or Sb; Ge, Sn or Pb, In or Ga, are observed. The results show that the effective suppression of residual defects of the recrystallized layers is vinculated to the redistribution of impurities via thermal diffusion. DOE

N88-29592# Sao Paulo Univ. (Brazil). Inst. de Fisica.
DEVELOPMENT OF Nb-Ti MULTIFILAMENTAR SUPERCONDUCTING WIRES M.S. Thesis
J. Otubo 1986 121 p In PORTUGESE
(DE88-702324; INIS-BR-1061) Avail: NTIS HC A06/MF A01

Ni-Ti superconducting wires with multifilamentary configuration were produced, using the grouping technique. Some basic concepts on superconductivity and its main critical parameters are presented. The criteria for stabilizing superconductors in terms of the geometry

are studied. The main critical parameter, H(sub c), J(sub c), T(sub c) in function of the composition and the metallurical structure of Ni-Ti alloy are analyzed. The development of Ni-Ti superconducting wires is described. DOE

N88-29593# Universidade Estadual de Campinas (Brazil). Inst. de Fisica.
STUDY OF SUPERCONDUCTING PROPERTIES IN SOME MANY VALLEY SEMICONDUCTORS Ph.D. Thesis
H. V. daSilveira 1986 84 p In PORTUGUESE: ENGLISH summary
(DE88-702325; INIS-BR-1062) Avail: NTIS HC A05/MF A01

The problem of superconducting transition in many valley semiconductors is considered, within a two-band model. The dominant mechanism comes from the attractive interaction between electrons of different valleys. The intravalley pairing is neglected since the shielding is very strong. Using the Green's function method, properties of the superconducting state are outlined, such as: quasiparticle spectrum, density of state and transition temperature. The a.c. - conductivity is calculated using the general theory of linear response. For the particular case the chalcogenide PbTe:Tl the effect of random impurities on the conductivity is considered. The results obtained for the transition temperature as a function of the carrier concentration are compared with the experimental results. The conductivity is checked against known theoretical results. DOE

N88-29594# Sandia National Labs., Albuquerque, N. Mex.
CHEMICAL KINETICS OF HYDROGEN AND P(SUB b) CENTERS
K. L. Brower 1988 10 p Presented at the Symposium on the Physics and Chemistry of SiO(sub 2) and the Si-SiO(sub 2), Atlanta, Ga., 15 May 1988
(Contract DE-AC04-76DP-00789)
(DE88-010528; SAND-87-2667C; CONF-8805116-1) Avail: NTIS HC A02/MF A01

Electron paramagnetic resonance (EPR) measurements indicate that P(sub b) centers, which are a dangling-bond type of defect at the (111) Si-SiO(sub 2) interface, can be passivated with H(sub 2) at a rate which is proportional to the H(sub 2) concentration in the thermal oxides and the interfacial density of P(sub b) centers. This process is characterized by an activation energy, E(sub f), of 1.66 + or - 0.06 eV with a second-order pre-expotential factor, k2(sub of), of 1.94 (+ 2./- 1.) times 0.000001 cu cm/sec for temperatures between 230 and 260 C. The passivation process is demonstrated to be consistent with a chemical process in which H(sub 2) molecules, during the course of their duffusional motion among the accessible interstices of the SiO(sub 2) network and the reaction site at P(sub b) centers, react directly with P(sub b) centers. EPR measurements indicate that passivated P(sub b) centers, denoted as HP(sub b), in effect dissociate in vacuum above 550 C. DOE

N88-29595# Southern Methodist Univ., Dallas, Tex. Dept. of Electrical Engineering.
LASER INDUCED CHEMICAL VAPOR EPITAXIAL GROWTH OF GALLIUM ARSENIDE FILMS Annual Report, Aug. 1987 - May 1988
Shirley S. Chu and Ting L. Chu 23 May 1988 30 p
(Contract N00014-86-K-0740)
(AD-A194254) Avail: NTIS HC A03/MF A01 CSCL 07B

The objective of this project is to investigate the epitaxial growth of device quality 3 to 5 semiconductor films by the free electron laser-induced epitaxial growth technique at low temperatures. Efforts during the past year has been focused to the homo- and heteroepitaxial growth and characterization of gallium arsenide (GaAs) films on GaAs and silicon (Si) substrates by laser-induced metalorganic chemical vapor deposition (LIMOCVD). ArF excimer laser (193 nm) was used before the free electron laser is available. The reaction between trimethylgallium and arsine in hydrogen under reduced pressure was used for the epitaxial growth of GaAs. Homoepitaxial GaAs films deposited by LIMOCVD at 425 - 500 C are similar to conventional homoepitaxial GaAs films (at 700 C) in properties. Heteroepitaxial GaAs films on Si substrates of (100) orientation have been deposited at 500 C by LIMOCVD with emphasis on the cleanliness of the substrate surface. Transmission electron microscopy and Raman spectra indicated that the heteroepitaxial GaAs films are presumably of a (111) orientation and that their crystalline perfection is superior to those deposited by other techniques. GRA

N88-29596# Rochester Univ., N. Y. Dept. of Electrical Engineering.
PHASE SENSITIVE AMPLIFICATION WITH SIS (SUPERCONDUCTOR-INSULATOR-SUPERCONDUCTOR) QUASIPARTICLE MIXERS Annual Report, 15 Jan. 1987 - 14 Jan. 1988
Mark F. Bocko 28 Mar. 1988 2 p
(Grant AF-AFOSR-0131-87)
(AD-A194594; AFOSR-88-0452TR) Avail: NTIS HC A02/MF A01 CSCL 09A

We have obtained the SIS junctions and RF choke structures which we will use in our experiments. These were fabricated for this project by Dr. Michael Cromar at the National Bureau of Standards Cryoelectronics Laboratory in Boulder Colorado. We have measured the dc characteristics of these junctions and have found that they have low leakage currents and RC products that are very close to our design goal. We have made preliminary calculations of the SIS mixer conversion efficiency for the real dc characteristics of our junctions and find that the results show the required phase sensitive response. GRA

N88-29597# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
RESEARCH ON CRYSTAL AND FILM FERROELECTRIC MATERIALS FOR OPTOELECTRONIC APPLICATIONS Annual Report, 1 Mar. 1986 - 28 Feb. 1987
R. R. Neurgaonkar Mar. 1988 204 p
(Contract N00014-81-C-0463)
(AD-A193512; SC5345.AR) Avail: NTIS HC A10/MF A01 CSCL 09E

The millimeter wave dielectric behavior of several tungsten bronze ferroelectrics is presented, along with a theoretical evaluation of the origin of the dielectric losses which are shown to arise from polar microdomain fluctuations. Data is also presented for new, La-modified bronze SBN:60 crystals which have very large dielectric constants at room temperature. A comprehensive thermodynamic phenomenology is presented for SBN:60, showing a unique tetracritical phase transition behavior for this ferroelectric. This same phenomenology fails for bronze BSKNN crystals, however, indicating a heretofor unrecognized improper ferroelastic contribution to the dielectric properties. GRA

N88-29598# Paris VI Univ. (France). Lab. de Physique des Solides.
HIGH POWER STORAGE SYSTEM BASED ON THIN FILM SOLID IONICS Final Report, Jul. 1985 - Feb. 1988
M. Balkanski and C. Julien Feb. 1988 19 p
(Contract DAJA45-85-C-0020; DA Proj. 1L1-61102-BH-57)
(AD-A193623; R/D-4867-PH-01) Avail: NTIS HC A03/MF A01 CSCL 20L

Thin film insertion cathodes obtained in the In-Se system and with a Hall mobility up to 50 sq cm (V sub s) have been measured on annealed films. Electrochemical lithium intercalation has been performed and shows that a plateau appears at 1.8V. The redox stability range has been determined by cyclic voltametry for different preparation conditions of the films. Lithium solid state hybrid systems using borate glasses as electrolyte and lamellar compounds as intercalated electrodes have been tested from the point of view of storage applications. The secondary prototype built with a composite electrode including NiPS3, carbon and powdered electrolyte have been set up and checked. Both thermodynamic and kinetic parameters are given under high power storage conditions. GRA

N88-29599# Harry Diamond Labs., Adelphi, Md.
ABSORPTION SPECTRA AND ENERGY LEVELS OF Gd(3+), Nd(3+) AND Cr(3+) IN THE GARNET Gd3Sc2Ga3O12 Interim Report, Oct. 1986 - Jun. 1987
John B. Gruber, Marian E. Hills, Clyde A. Morrison, Gregory A. Turner, and Milar R. Kokta Mar. 1988 36 p
(AD-A193634; HDL-TR-2136) Avail: NTIS HC A03/MF A01 CSCL 07B

Absorption spectra recorded between 0.3 and 6.7 microns are reported for trivalent gadolinium, trivalent neodymium, and trivalent chromium in single-crystal gadolinium scandium gallium garnet, Gd3Sc2Ga3O12, at liquid nitrogen and room temperatures. Crystalline electric-field-split energy levels are established from data between 1,5000 and 35,000/cm for Gd3+ (4f7), Nd3+ (4f3), and Cr3+ (3d3). The Gd3+ and Nd3+ ions occupy sites having D2 point symmetry; Cr3+ ions are found primarily in sites of C3i point symmetry. A Hamiltonian consisting of Coulombic, spin-orbit, and crystalline electric-field terms, having symmetry appropriate to each ion, is diagonalized to obtain theoretic energy levels. The rms deviation between calculated and observed levels for Nd3+ (with 45 levels) is 1.7/cm, for Gd3+ (with 14 levels) is 4/cm, and for Cr3+ (with 35 levels) is 87.7/cm. A lattice sum calculation is compared with the phenomenological parameters obtained from fitting the observed energy levels. GRA

N88-29600# Mercury LPE Co., Inc., Pittsburgh, Pa.
LATTICE-MATCHED HgZnTe EPITAXY DEVELOPMENT Final Report, Aug. 1986 - Oct. 1987
David G. Ryding Apr. 1988 80 p
(Contract F33615-86-C-5085)
(AD-A193677; AFWAL-TR-87-4133) Avail: NTIS HC A05/MF A01 CSCL 20B

The technical feasibility of growing HgZnTe on CdZnTe for longwave infrared applications has been demonstrated in this Phase 1 program. Mercury Company has developed a technique for growing reproducible large area uniform HgZnTe. The proposed research was to focus on longwave infrared (LWIR) HzZnTe, and Mercury Company routinely achieves cutoff wavelengths of 7.0 to 10.6 microns at room temperature. High quality large area Cd(0.8)Zn(0.2)Te substrates were developed by Galtech Semiconductor Materials Corporation, Utah. High resolution surface and internal IR inspection of substrates was achieved using image analysis; techniques were developed that could lead to automated inspection. In addition, SEM capabilities were developed that could lead to automated inspection of epitaxy material. GRA

N88-29601# Innsbruck Univ. (Austria). Inst. of Experimental Physics.
HOT ELECTRON EMISSION IN SEMICONDUCTORS Final Technical Report No. 7, 26 Nov. 1984 - 29 Feb. 1988
Erich Gornik, Karl Unterrainer, and Manfred Helm 25 Mar. 1988 117 p
(Contract DAJA45-84-C-0052)
(AD-A194101; R/D-4410-EE-01) Avail: NTIS HC A06/MF A01 CSCL 20L

The spectrum of the simulated far infrared emission from p-Germanium in crossed electric and magnetic fields is studied by means of a tunable narrow-band GaAs-detector. A multimode spectrum is observed from polished high parallel samples. The mode spectrum is quantitatively explained in terms of internal waveguide-like modes. With the help of an external resonator the number of modes was drastically reduced. The external resonator has a confocal configuration. For the first time a single mode operation is demonstrated. The problem of the electron distribution in crossed electric and quantizing magnetic fields is treated for free electrons in a parabolic band. The master equation for the diagonal elements of the density matrix is solved including the k sub z dependence of the electron distribution. It is shown that population inversion between Landau levels can be achieved if scattering by optical phonons and a quasi-elastic scattering process are taken into account. GRA

N88-29602*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PLANAR THIN FILM SQUID WITH INTEGRAL FLUX CONCENTRATOR Patent Application
Palmer N. Peters, inventor (to NASA) and Robert C. Sisk, inventor (to NASA) 11 Jul. 1988 15 p
(NASA-Case-MFS-28282-1; NAS 1.71:MFS-28282-1; US-Patent-Appl-SN-217533) Avail: NTIS HC A03/MF A01 CSCL 20L

A thin film SQUID is disclosed having improved flux concentration combined with simplicity of design and fabrication. The SQUID starts with a wafer like substrate having simple planar geometry. A large area of superconducting film is coated on the substrate, with a small open or uncoated area remaining at its center to define a SQUID loop, and a gap in the film formed, beginning at the outer circumferential edge of the substrate and extending radially inward to the open area. A Josephson junction is formed across the gap near the open area to interrupt the electrical continuity of the SQUID loop. A coil is attached to the surface of the substrate, electrically insulated from the superconducting film, and is energized to induce flux within the SQUID which is concentrated within the open area. NASA

N88-29603# International Centre for Theoretical Physics, Trieste (Italy).
FLUCTUATIONS OF ORDER PARAMETERS IN THE HIGH T(SUB c) SUPERCONDUCTORS
M. P. Das and A. G. Saif Jul. 1987 12 p
(DE88-702549; IC-87/179) Avail: NTIS (US Sales Only) HC A03/MF A01

Recently we have proposed a phenomenological approach in terms of two coexisting macroscopic order parameters corresponding to the superconducting and insulating states and have discussed the electrodynamical responses of the superconducting ceramics. In this paper we discuss the fluctuations of the order parameters both in the static and in the dynamical situations in the mean field approach and obtain results for the electrical conductivity which possesses anomalies as in granular materials. DOE

N88-29604# International Centre for Theoretical Physics, Trieste (Italy).
THEORETICAL INVESTIGATION OF IMAGE STATES OF THE HYDROGEN COVERED Cu (100)
M. Steslicka, M. Zagorski (Warsaw Univ., Poland), and L. Jurczyszyn Aug. 1987 24 p Submitted for publication
(DE88-702662; IC-87/218) Avail: NTIS (US Sales Only) HC A03/MF A01

A model of atomic-hydrogen-covered Cu(100) is presented and the calculated energy spectrum of localized electronic states in the X gap of Cu(100) is discussed. These states form a series of unoccupied adsorption image states (for n sub alpha = 2,3,...) lying below the vacuum level V sub 0 and having energies E sub n alpha which satisfy the formula E sub n alpha = V sub 0 - 10 n sub n sup 2 (eV). The lowest state (n sub alpha = 1) is expected to lie about 5.5 (eV) below Fermi level. DOE

N88-29605# International Centre for Theoretical Physics, Trieste (Italy).
ANOMALOUS DEPENDENCE OF THE THERMOELECTRIC POWER ON THE TEMPERATURE IN YBaCuO HIGH-T(SUB c) SUPERCONDUCTING SAMPLES
T. Porjesz, T. Karman, T. Kirschner, G. Kovacs, G. Zsolt, and H. Beyer (Central Research Inst. for Chemistry, Budapest, Hungary) Oct. 1987 9 p
(DE88-702682; IC-87/278) Avail: NTIS (US Sales Only) HC A02/MF A01

Experimental thermoelectric measurements were carried out on high-T(sub c) superconductors. The results have shown a p-type semiconductor-like conduction above the critical temperature and an n-type behavior below it. DOE

N88-29606# International Centre for Theoretical Physics, Trieste (Italy).
SYSTEM SUITABLE FOR OBSERVING SURFACE PLASMON IN A SEMI-INFINITE SEMICONDUCTOR SUPERLATTICE
Yun Zhu, Shengshan Cai, and Shixun Zhou Aug. 1987 13 p
(DE88-702686; IC-87/284) Avail: NTIS (US Sales Only) HC A03/MF A01

A model of semi-infinite semiconductor superlattice topped with a metal-insulator (M-I-SL) is suggested. A modified Giuliani-Quinn surface plasmon is found. It is interesting to note that the frequency and critical wavelength can be arbitrarily chosen by varying thickness of the insulator. In particular, a new type of surface plasmon with null critical wave vector exists only below the bulk plasmon continuum, and the frequency is directly related to the ratio of thickness of the insulator d to the superlattice spacing a. DOE

N88-29607# International Centre for Theoretical Physics, Trieste (Italy).
LOCALIZED EXCITATIONS IN ONE-DIMENSIONAL MOLECULAR CRYSTAL WITH STRUCTURAL DEFECT
B. Cabric and L. Ristovski Oct. 1987 11 p
(DE88-702691; IC-87/289) Avail: NTIS (US Sales Only) HC A03/MF A01

The linear chain in molecular crystal with local structural defect (dislocation) has been considered. By applying a particular theoretical approach the energies of localized excitations appearing in the system are determined and the dependence of these energies on the perturbation parameters is discussed. The theoretical approach is formulated in such a way to reduce the problem to the analysis of an ideal molecular chain with some extra off-diagonal terms in the Hamiltonian. These extra terms are considered as perturbation caused by the nonideality of the molecular chain. The results of the present study provide the first step towards the quantitative understanding of the effects of structural disorder on exciton dynamics, energy transfer processes and absorption line shapes in quasi-one-dimensional molecular crystals. DOE

N88-29608# International Centre for Theoretical Physics, Trieste (Italy).
NEW METHOD FOR PREPARATION OF (Cd, Hg)Te THIN FILMS
Van Khai Nguyen, Thi Phuong Ho, Hong Ngat Ta, and Van Sung Nguyen Nov. 1987 11 p
(DE88-702727; IC-87/336) Avail: NTIS (US Sales Only) HC A03/MF A01

A new method for the preparation of (Cd,Hg)Te thin films has been described. This method is based on deposition of polycrystal Cd(sub z)Hg(sub 1-z)Te on a single crystal CdTe slice. The growth process is carried out in a strong temperature gradient of (50 to 100)K pre cm during a period of (1 to 24) hours. The optical parameters of the grown films have been measured at the room temperature while the electrical parameters at liquid nitrogen temperature. DOE

N88-29609# International Centre for Theoretical Physics, Trieste (Italy).
INFLUENCE OF THE TEMPERATURE-DEPENDENCE OF RECOMBINATION LIFE-TIME OF FREE CARRIERS IN AMORPHOUS SEMICONDUCTORS ON THERMOSTIMULATED PHOTOCURRENT SPECTRA
Zhengyi Xu, Benyuan Gu, Bizhen Dong, and Meifang Zhu Nov. 1987 13 p
(DE88-702728; IC-87/337) Avail: NTIS (US Sales Only) HC A03/MF A01

In previous theoretical analysis of thermostimulated conductivity (TSC) in amorphous semiconductors, for the sake of simplicity, we assumed that the recombination life-time tau of free carriers is a constant independent of temperature. In fact, this assumption is incomplete. The influence of the temperature-dependence of tau on thermostimulated conductivity spectra is investigated in the present work. Under the consideration of T-dependence of tau, all the characteristics of TSC spectra indicated by the previous theoretical analysis still remain valid qualitatively, but the quantitative results are considerably changed. The effect of the relaxation parameters describing the behavior of tau(T) on the TSC spectra is also discussed. DOE

N88-29610# International Centre for Theoretical Physics, Trieste (Italy).
VIBRATION SPECTRA INDUCED BY IMPURITIES IN 3-5-COMPOUNDS SEMICONDUCTORS
Wenlan Xu and S. C. Shen Sep. 1987 12 p
(DE88-702730; IC-87/339) Avail: NTIS (US Sales Only) HC A03/MF A01

The vibration spectra induced by different impurities in semiconductor 3-5-compounds are discussed. The numerical results for the case of Gallium Phosphide are given and compared with experimental results. DOE

N88-29611# International Centre for Theoretical Physics, Trieste (Italy).
DEPENDENCE OF HIGH CRITICAL TEMPERATURE OF CERAMIC SUPERCONDUCTORS ON THE NOMINAL Cu(SUP 3+)Cu(SUP 2+) RATIO
A. G. Saif Oct. 1987 9 p
(DE88-702734; IC-87/343) Avail: NTIS (US Sales Only) HC A02/MF A01

The dependence of the superconducting-insulating transition (T sub c) and the insulator-metal transition (approximately T sub c) on the nominal ratio tau of Cu(sup 3+)/Cu(sup 2+) has been estimated. This ratio tau ident to tau(delta) seems to guide the T sub c by exhibiting a broad maximum, where the hole density delta has been formulated as a function of the doping-x and the oxygen deficiency-y. An agreement with the experimental results has been found. DOE

N88-29612# International Centre for Theoretical Physics, Trieste (Italy).
THERMOSTIMULATED CONDUCTIVITY IN AMORPHOUS SEMICONDUCTORS WITH NON-EXPONENTIAL DENSITY OF LOCALIZED STATES
Zhengyi Xu, Huaguang Yang, and Benyuan Gu Nov. 1987 12 p
(DE88-702737; IC-87/350) Avail: NTIS (US Sales Only) HC A03/MF A01

We calculate the thermostimulated conductivity (TSC) in amorphous semiconductors with non-exponential density of localized states (DOS) that has been obtained from the measurements of the field-effect by Weisfield et al. (Phil. Mag. B44(1981),83). The calculated results are compared with the case of exponential density of localized states. It turns out that the low-T-peak in the TSC becomes higher than the high-T-peak when the non-exponential DOS is rapidly increased in the high energy region. Except for this point, the profile of TSC in these two cases does not exhibit a substantial difference, but the results are quantitatively different. DOE

N88-29613# Sao Paulo Univ., Sao Carlos (Brazil). Dept. de Engenharia de Materiais.
PREPARATION AND TESTING OF Nb-Zr AND Nb-ZrO2 SINGLE CRYSTALS FOR DEFORMATION STUDIES
W. J. BottaFilho, J. W. Christian, and G. Taylor 1987 16 p
Presented at the 42nd Annual Congress of the Brazilian Association of Metals, Salvador, Brazil, 18 Oct. 1987
(DE88-702798; INIS-BR-1102; CONF-8710277) Avail: NTIS (US Sales Only) HC A03/MF A01

The difficulties to obtain adequate single crystals of Nb-Zr and Nb-ZrO(sub 2) alloys for deformation studies are discussed. Low-temperature internal oxidation of Nb-Zr alloys followed by ageing at higher temperatures resulted in the precipitation of ZrO(sub 2) particles. However, the effect of this treatment on the particles size and distribution and on the crystallographic structure of the particle was not completely understood. Compression tests in the temperature range 4.2 K to 373 K showed a small effect of

zirconia particles on the mechanical properties of Nb-Zr solid solutions and a significative effect of the amount of oxygen remaining in solid solution after the oxidation treatment. DOE

N88-29614# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.
ELECTRICAL CONDUCTIVITY OF GaAs LAYERS IMPLANTED ON SEMI-INSULATOR NONDOPED SUBSTRATES Final Report [CONDUCTIVITE ELECTRIQUE DE COUCHES GAAS IMPLANTEES SUR SUBSTRATS SEMI-ISOLANTS LEC NON DOPES]
J. P. Dabid, J. F. Faucheux, and A. Roizes Dec. 1986 58 p In FRENCH
(Contract DRET-85-1404)
(CERT-422000/RF; ETN-88-92890) Avail: NTIS HC A04/MF A01

A model to estimate the conductivity of an ion implantation layer, based on the knowledge of the mobilities and the free carriers, is presented. The mobility and free carriers profiles are determined using a magnetotransconductance method. Anomalies of the conductivity are explained as related to the semi-insulator substrate compensating power. The variations of conductivity as a function of the temperature are estimated by the model. ESA

N88-29615# Leiden Univ. (Netherlands).
THE THERMAL CONDUCTIVITY OF DIRTY TYPE 2 SUPERCONDUCTORS Ph.D. Thesis
Josephus Petrus Mari vanderVeeken 1986 99 p
(B8681488; ETN-88-92895) Avail: NTIS HC A05/MF A01

Thermal conductivity in the normal and Meissner state are reviewed, for electrons and phonons as heat carriers, and also the various scattering mechanisms involved. Methods to obtain a detailed description of the structure of the mixed state and the calculation of transport properties, as can be derived from the Gorkov-Eilenberger theory, are discussed. Measurements on the weak coupling (BCS) superconductor alloy Sn 0.84 In 0.16 are described. The measured anisotropy in the thermal conductivity is found to agree quite well with that predicted for the electrons, throughout the mixed state regime. For the lower temperatures the phonon thermal conductivity is found to be in good agreement with that calculated from the low frequency limit of the ultrasonic attenuation. The strong coupling superconductor Pb 0.79 In 0.21 is discussed. The theory still provides a correct description after a straightforward scaling procedure, for the electron and phonon conductivity. Evidence for an anisotropic phonon conductivity at low temperatures and inductions is found. ESA

N88-29616# Regensburg Univ. (West Germany). Fakultaet fuer Physik.
TEMPERATURE DEPENDENCE OF CONDUCTIVITY AND OF HALL COEFFICIENTS FOR NOBLE METAL FILMS Ph.D. Thesis [TEMPERATURABHAENGIGKEIT DER LEITFAEHIGKEIT UND DES HALLKOEFIZIENTEN DUENNER EDELMETALLSCHICHTEN]
Franz Hofmann 1986 137 p In GERMAN
(ETN-88-92981) Avail: NTIS HC A07/MF A01

Carrier transport in electric and magnetic fields for free electron gases is studied. Conductivity and Hall effect for monocrystals are explained by Boltzman theory for electrical transport mechanism. Hall effect depends on Fermi surface anisotropy and a simplified relation between Fermi surfaces and Hall effect for noble metals determines a two band model. Surface influence on the conduction mechanism of thin metal films for free electron gases is described by Fuchs-Sondheimer theory. ESA

N88-29617# Stuttgart Univ. (West Germany). Fakultaet fuer Physik.
MUON-SPIN ROTATION EXPERIMENT (MICRO + SR) ON ALUMINUM AND INDIUM AFTER LOW TEMPERATURE ELECTRON IRRADIATION Ph.D. Thesis [MYON-SPIN-ROTATIONSEXPERIMENTE (MICRO + SR) AN ALUMINIUM UND INDIUM NACH TIEFTEMPERATURBESTRAHLUNG MIT ELEKTRONEN]
Norbert Kurt Haas 1987 141 p In GERMAN
(ETN-88-92985) Avail: NTIS HC A07/MF A01

Vacancy properties in crystals are investigated by positive muons after electron irradiation of Al samples between 9 to 80 K and indium samples at 10.8 K. For Al probes, capture behavior of muons by radiation induced defects and defect restoration is analyzed. Diffusion mechanism from incoherent tunneling processes between 4 to 40 K is determined. For In probes it is demonstrated that muons are localized in intergrid areas for temperatures under 35 K and are mobile thereafter. Muons are captured by induced defects at temperatures above 70 K. ESA

N88-29618*# National Aeronautics and Space Administration, Washington, D.C.
DIAMOND FILM BY HOT FILAMENT CVD METHOD
Y. Hirose Sep. 1988 14 p Transl. into ENGLISH from Seimitsu Kogaku Kaishi, (Japan), v. 53, no. 10, 1987 p 1507-1510 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20335; NAS 1.77:20335) Avail: NTIS HC A03/MF A01 CSCL 20L

Diamond synthesis by the hot filament CVD method is discussed. A hot filament decomposes gas mixtures and oxygen containing organic compounds such as alcohols. which are carbon sources. The resulting thin films, growth mechanisms, and characteristics and problems associated with the hot filament CVD method are analyzed and evaluated. Author

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-29619# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TOWARDS A FINITE QUANTUM GRAVITY
D. I. Kazakov 1987 6 p Submitted for publication
(DE88-701497; JINR-E-2-87-209) Avail: NTIS (US Sales Only) HC A02/MF A01

It is shown that in Einstein quantum gravity one can achieve the cancellation of all the ultraviolet divergences on a mass shell by an appropriate choice of the background metric. In the framework of dimensional regularization g sub mu nu sup B = sigma sub larger than or = 0 g sub mu nu sup (k)x epsilon sup k, where the classical metric g/sub mu nu sup (0)obeys the Einstein equation R sub mu nu(g sup (0))=0. DOE

N88-29620# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE MEANING OF PERTURBATION EXPANSIONS IN QUANTUM FIELD THEORY
C. Burdik and J. Chyla 1987 19 p
(DE88-702138; JINR-E-2-87-325) Avail: NTIS (US Sales Only) HC A03/MF A01

We reformulate perturbation expansions in renormalized quantum field theories in a way that allows straightforward handling of situations when in the conventional approach (i.e., in fixed renormalization scheme) these expansions are divergent. In our approach the results of perturbation calculations of physical quantities appear in the form of (under certain circumstances) convergent expansions in powers of a free parameter chi,

characterizing the procedure involved. This inherent ambiguity of perturbative calculations is conjectured to be an expression of the underlaying ambiguity in the separation of the full theory into its perturbative and nonperturbative parts. The close connection of our results with the Borel summation technique is demonstrated and their relation to conventional perturbation expansions in fixed renormalization schemes is clarified. DOE

N88-29621# Indiana Univ., Bloomington. Dept. of Physics.
THEORETICAL PARTICLE PHYSICS Technical Progress Report
S. A. Gottlieb May 1988 42 p
(Contract DE-AC02-84ER-40125)
(DE88-011499; DOE/ER-40125/14) Avail: NTIS HC A03/MF A01

Research in lattice gauge theory during the past year is described. Several projects were completed dealing with QCD simulations including dynamical fermions. A study of the spectrum of QCD was combined with a study of the finite temperature chiral symmetry restoration transition in order to determine the transition temperature in MeV. The transition temperature is seen to be approx. 130 MeV, which makes it more accessible to observation at a relativistic heavy-ion collider than previously expected. Studies of hadronic screening lengths and the quark number susceptibility at zero chemical potential provide further probes of the high temperature phase of QCD. Work has continued on algorithm development with the publication of one paper on systematic errors as a function of step size and conjugate gradient residual, and work in progress on fermion matrix preconditioning and global accept-reject algorithms. DOE

N88-29622# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
TIME TRAVEL IN THE HOMOGENEOUS SOM-RAYCHAUDHURI UNIVERSE
F. M. Paiva, M. J. Reboucas, and A. F. F. Teixeira 1987 14 p
(DE88-702220; CBPF-NF-056/87) Avail: NTIS (US Sales Only) HC A03/MF A01

Properties of the rotating Som-Raychaudhuri homogeneous space-time are investigated: time-like and null geodesics, causality features, horizons and invariant characterization. An integral representation of its five isometries is also discussed. DOE

N88-29623# Centro di Cultura Scientifica A. Volto, Como (Italy).
CHAOTIC BEHAVIOUR IN QUANTUM DYNAMICS Interim Report No. 1
Giulio Casati 1987 11 p
(Contract DAJA45-88-C-0003)
(AD-A193936; R/D-5653-PH-01) Avail: NTIS HC A03/MF A01 CSCL 20J

This research work is generally devoted to the investigation of the relevance of classical chaos to quantum mechanics, with special emphasis on quantum systems subjected to perturbations periodic in time. GRA

N88-29624# International Centre for Theoretical Physics, Trieste (Italy).
PASSAGE OF RELATIVISTIC MAGNETIC DIPOLE MOMENTS THROUGH MAGNETIC FIELDS
A. O. Barut and M. Bozic Jul. 1987 35 p
(DE88-702640; IC-87/168) Avail: NTIS (US Sales Only) HC A03/MF A01

We have solved the Dirac equation with an anomalous moment Pauli-coupling exactly for a constant magnetic field and derived the general relativistic formulas for phase changes due to translational motion and spin rotations. We also give transmission and reflection coefficients, spin rotation for tunnelling and barrier penetration. DOE

N88-29625# International Centre for Theoretical Physics, Trieste (Italy).
CAN WE CALCULATE THE FUNDAMENTAL DIMENSIONLESS CONSTANTS OF PHYSICS
A. O. Barut Jul. 1987 14 p
(DE88-702641; IC-87/187) Avail: NTIS (US Sales Only) HC A03/MF A01

We review some dynamical models to calculate the dimensionless constants which are associated with the four different manifestations (electromagnetic, strong, weak and gravitational) of a possible single interaction. DOE

N88-29626# International Centre for Theoretical Physics, Trieste (Italy).
RELATIVISTIC THEORY OF THE LAMB SHIFT BASED ON SELF ENERGY
A. O. Barut and Y. I. Salamin Jul. 1987 39 p
(DE88-702658; IC-87/210) Avail: NTIS (US Sales Only) HC A03/MF A01

A study is made to evaluate the Lamb shift to all orders in (Z alpha) using relativistic Dirac Coulomb wavefunctions and without resorting to the dipole approximation. Use is made of the angular integrals and spins sums performed elsewhere exactly. A regularization procedure is given that makes the sum over the positive and negative energy states finite. Finally, the energy shift delta E(sub n)(sup LS) is given in terms of an integral that may be done numerically. DOE

N88-29627# International Centre for Theoretical Physics, Trieste (Italy).
HOLOMORPHIC GEOMETRY OF INTERACTING STRING
Saito Takesi and Ke Wu Oct. 1987 8 p
(DE88-702714; IC-87/320) Avail: NTIS (US Sales Only) HC A02/MF A01

The geometric quantization of Bowick and Rajeev are applied to interacting bosonic strings. We calculate the total curvature of the two bundles over Diff S^1S^1. The requirement of vanishing of the total curvature leads not only to the critical dimension d=26, but also to constraint equations for vertex operators. We find two solutions to these equations for external scalar fields which are interacting with the open string. Other interactions with vector field, weak gravitational field and so on are also discussed. DOE

N88-29628# Stockholm Univ. (Sweden). Dept. of Theoretical Physics.
THE HILBERT SPACE OF THE OPEN BOSONIC STRING
Mats Nilsson Jan. 1988 39 p
(USIP-88-02; ETN-88-92812) Avail: NTIS HC A03/MF A01

Mode expansion is used to solve for the dependence of the Fourier components with mode number greater than zero after quantization of the mass shell condition of a boson. The zero mode is the translational mode and can thus be identified with spacetime. Mode expansion and the standard unification of constraints produce the Virasoro conditions. The Virasoro operators are considered as a sum of differential operators. Thus the Virasoro conditions are a set of differential equations. Analysis of the properties of the solutions to these equations shows that the Virasoro conditions can be reduced to a set of field equations for the spacetime mode. All the field equations are derived, reducing the Hilbert space of the bosonic string to that of a field theory defined on spacetime, i.e., producing a string field theory. ESA

N88-29629# Loughborough Univ. of Technology (England). Dept. of Mathematics.
ON NEUTRINO FIELDS IN EINSTEIN-CARTAN THEORY
P. Singh and J. B. Griffiths May 1988 6 p
(Math-Rept-208; ETN-88-93144) Avail: NTIS HC A02/MF A01

An approach to classical neutrino fields in Einstein-Cartan theory is described using a generalized method of spin-coefficients. It is pointed out that this approach is particularly suitable for the generation of exact solutions from known solutions in general relativity, and an example is given. ESA

N88-29630# Loughborough Univ. of Technology (England). Dept. of Mathematics.
ON THE DEGENERATE FERRARI-IBANEZ SOLUTION FOR COLLIDING PLANE GRAVITATIONAL WAVES
J. B. Griffiths May 1988 6 p
(Math-Rept-209; ETN-88-93145) Avail: NTIS HC A02/MF A01

The degenerate case of the soliton solution of Ferrari and Ibanez is considered. This describes the collision of two gravitational plane waves in a flat background. This solution is a Schwarzschild space-time and, compared with other solutions of this type, the future space-like singularity is replaced by the horizon. However, it is shown that this still forms a boundary for real particles. It is also shown that in this, and in a more general solution of Chandrasekhar and Xanthopoulos, there exist two point singularities. The global singularities structure is therefore identical to that of the Bell-Szekeres solution. ESA

N88-29631*# National Aeronautics and Space Administration, Washington, D.C.
THE CONSTRUCTION OF THE THERMOELASTICITY EQUATIONS ON THE BASIS OF CONTEMPORARY NOTIONS OF NONLINEAR CONTINUA MECHANICS
G. A. Kilchinskaya Aug. 1988 8 p Transl. into ENGLISH from Matematicheskaia Fiziki i Nelineinaia Mekhanika (USSR), no. 8, 1987 p 62-66 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20307; NAS 1.77:20307) Avail: NTIS HC A02/MF A01 CSCL 20C

The fundamental concepts of the theory of simple thermomechanical materials are applied to a thermoelastic medium. Nonlinear coupled thermoelasticity equations are derived, with free energy and heat flux approximated by polynomials of deformation and temperature invariants. Details of the derivation procedure are presented. Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-29632# General Accounting Office, Washington, D. C. National Security and International Affairs Div.
COMPETITION: ISSUED ON ESTABLISHING AND USING FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS
Mar. 1988 57 p
(PB88-178884; GAO/NSIAD-88-22) Avail: NTIS HC A04/MF A01 CSCL 05A

The national defense role of Federally Funded Research and Development Centers is documented. Information is presented on the placement of research and development work at 12 centers: 10 sponsored by the Department of Defense and 2 sponsored by the Department of Energy. Author

N88-29383*# Martin Marietta Aerospace, Denver, Colo.
A SCHEDULING AND RESOURCE MANAGEMENT SYSTEM FOR SPACE APPLICATIONS
Daniel L. Britt, Amy L. Geoffroy, and John R. Gohring *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 303-310 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05A

N88-29384*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
AN EXPERT SYSTEMS APPLICATION TO SPACE BASE DATA PROCESSING
Stephen M. Babb *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 311-318 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05A

N88-29404*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENT SCHEDULING FOR SPACELAB MISSIONS
John Jaap and Elizabeth Davis *In its* Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 475-488 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-29633# Ohio State Univ., Columbus.
DISTRIBUTED KNOWLEDGE BASE SYSTEMS FOR DIAGNOSIS AND INFORMATION RETRIEVAL
B. Chandrasekaran 8 Apr. 1988 160 p
(Grant AF-AFOSR-0090-87)
(AD-A193107; AFOSR-88-0572TR) Avail: NTIS HC A08/MF A01 CSCL 12I

This report summarizes work done in artificial intelligence. Research is reported in the following areas: applications of generic task methodology to learning, design, and planning; theoretical and critical studies of connectionism, neural nets, and symbolic computation; and studies of the uses of distributed systems for concurrent algorithms/implementation for abductive assembly, a basic generic problem solving task. Topics include: A corrective learning procedure using different explanatory types; A task oriented approach to knowledge-based systems for process engineering design; An information processing model of Japanese foreign and energy policy decision making; Understanding device feedback; Connectionism and information processing abstractions--The message still counts more than the medium; Some experiments with neural nets; From numbers to symbols to knowledge structures--AI perspectives on the classification task; and Distributed synthesis of composite explanatory hypotheses. GRA

N88-29634 Cornell Univ., Ithaca, N.Y.
EXPERIMENTS IN AUTOMATIC PHRASE INDEXING FOR DOCUMENT RETRIEVAL: A COMPARISON OF SYNTACTIC AND NON-SYNTACTIC METHODS Ph.D. Thesis
Joel L. Fagan 1988 278 p
Avail: Univ. Microfilms Order No. DA8804609

In order for an automatic information retrieval system to effectively retrieve documents related to a given subject area, the content of each document in the system's database must be represented accurately. The hypothesis that better representations of document content can be constructed if the content analysis method takes into consideration the syntactic structure of document and query texts is examined. Two methods of automatically generating phrases for use as content indicators were implemented and tested experimentally. The nonsyntactic (or statistical) method is based on simple text characteristics such as word frequency

and the proximity of words in text. The syntactic method uses augumented phrase structure rules (production rules) to selectively extract phrases from parse trees generated by an automatic syntactic analyzer. The PLNLP system was used for syntactic analysis of document and query texts, and for implementing the syntax-based phrase construction rules. The SMART information retrieval system was used for retrieval experiments.
Dissert. Abstr.

N88-29635 Rensselaer Polytechnic Inst., Troy, N.Y.
TECHNICAL COMMUNICATION IN THE COMPUTER INDUSTRY: AN INFORMATION-DEVELOPMENT PROCESS TO TRACK, MEASURE AND ENSURE QUALITY Ph.D. Thesis
Roger Alan Grice 1987 438 p
Avail: Univ. Microfilms Order No. DA8803441

The needs of the information society have thrust into prominence those who produce the technical information needed to work with computers. As a consequence of the need for technical information, those who develop and produce that information are called upon to translate the technical capabilities of complex computer systems into a form that enables readers to perform needed tasks. Since the information produced is an integral part of the product, it follows that the information developers must work as an integral part of the product-development team, not as post-facto wordsmiths who clean up the writing done by product developers. To function in this capacity, they need an information-development process that is consistent with the product-development process. Developing information in this environment is not simply following a set of rules for communicating correctly, but is a process for converting detailed technical information into information that enables users of high-technology products to do the tasks they want or need to do; it is not merely describing the structure of those products and the functions that are available. While the process is well defined in many of its aspects, it also possesses many implications for further research and development efforts by academic researchers and industrial practitioners alike.
Dissert. Abstr.

N88-29636# Connecticut Univ., Storrs.
DYNAMICALLY RECONFIGURABLE DISTRIBUTED DATABASE SYSTEMS Final Report, 28 Jun. 1985 - 27 Jan. 1988
Fred Maryanski Mar. 1988 10 p
(Contract DAAG29-85-K-0044)
(AD-A194716; ARO-21826.15-EL) Avail: NTIS HC A02/MF A01 CSCL 12G

One of the few common threads throughout most distributed database research projects has been the assumption that the network topology is stable. However, mobility and portability are often essential features of network nodes, especially (but not exclusively) in military applications. This project investigated both basic and applied research problems which arise when the presupposition of fixed topology is removed. The goal of this effort was to explore the essential issues of dynamically reconfigurable database systems and to develop a design strategy for such systems.
GRA

N88-29637# MacDonald, Dettwiler and Associates Ltd., Richmond (British Columbia).
CENTRAL USER AND BROWSE SERVICE Final Report
Paris, France ESA 18 Dec. 1987 186 p
(Contract ESA-6880/86-HGE-I(SC))
(CU-PG-MDA-SY-0005; ESA-CR(P)-2554; ETN-88-92776) Avail: NTIS HC A09/MF A01

User and system requirements for the ERS-1 ground segment were assessed. An architectural design to meet the overall system requirement was achieved. The system is user oriented in terms of flexibility and ease of use. A cost-effective solution was evolved in that standard commercial packages and networks are utilized allowing different types of on-line user communities to access the system with ease and to minimize integration difficulties. Software tools, including graphics, allow users to meet their needs by searching the catalog, which includes records of archived raw data and products, or by ordering the acquisition of new data. The use of powerful software tools allows a comprehensive and efficient use of system and satellite capabilities by facilitating required data acquisition within specified mission constraints.
ESA

N88-29353*# Alabama A & M Univ., Huntsville. Dept. of Computer Science.
A RELATIONAL DATA-KNOWLEDGE BASE SYSTEM AND ITS POTENTIAL IN DEVELOPING A DISTRIBUTED DATA-KNOWLEDGE SYSTEM
Eric N. Rahimian and Sara J. Graves (Alabama Univ., Huntsville.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 7-16 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05B

N88-29354*# Alabama Univ., Huntsville. Dept. of Computer Science.
HOLOGRAM REPRESENTATION OF DESIGN DATA IN AN EXPERT SYSTEM KNOWLEDGE BASE
S. G. Shiva and Peter F. Klon (Boeing Military Airplane Development, Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications Aug. 1988 p 17-38 (For primary document see N88-29351 23-61)
Avail: NTIS HC A99/MF E03 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N88-29638# Los Alamos National Lab., N. Mex.
NEW DEVELOPMENTS IN CAPITAL COST ESTIMATING
R. A. Stutz and M. A. Zocher 1988 7 p Presented at the 32nd Annual Meeting of the American Association of Cost Engineers and the 10th International Cost Engineering Congress, New York, N.Y., 10 Jul. 1988
(Contract W-7405-eng-36)
(DE88-005392; LA-UR-88-194; CONF-880728-1) Avail: NTIS HC A02/MF A01

The new developments in cost engineering revolve around the ability to capture information that in the past could not be automated. The purpose of automation is not to eliminate the expert cost engineer. The goal is to use available technology to have more information available to the professionals in the cost engineering field. In that sense, the demand for expertise increases in order to produce the highest quality estimate and project possible from all levels of cost engineers. We cannot overemphasize the importance of using a good source of expert information in building these types of programs. Garbage in, garbage out still applies. Expert systems technology will become commonplace in many vertical markets; it is important to understand what can and cannot be accomplished in the field, and where this technology will lead in the future.
DOE

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-29639# Argonne National Lab., Ill.
ARGONNE NATIONAL LABORATORY TECHNOLOGY TRANSFER REPORT, FY87
Nov. 1987 33 p
(Contract W-31109-eng-38)
(DE88-010091; ANL-8010091) Avail: NTIS HC A03/MF A01

In 1985 Argonne established the Technology Transfer Center (TTC). As of the end of FY87, the TTC has a staff equivalent to four full-time professionals, two secretaries, and two student aides; FY87 ORTA funding was $220K. A network of technology transfer representatives provides windows into and out of Argonne's technical divisions on technology transfer matters. The TTC works very closely with the ARCH Development Corporation, a not-for-profit corporation set up to commercialize selected Argonne and University of Chicago patents. The goal of the Technology Transfer Center at Argonne is to transfer technology developed at Argonne to the domestic private sector by whatever means is most effective. The strategies by which this is accomplished are numerous and the TTC is, in effect, conducting a number of experiments to determine the most effective strategies. These include cooperative RandD agreements, work-for-others contracts, subcontracting to industry, formation of joint ventures via ARCH, residencies by industry staff at Argonne and vice versa, patent licensing and, of course, conferences, workshops and visits by industry, and to industry. DOE

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

No abstracts in this category.

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics.*

N88-29640 New Mexico State Univ., University Park.
ACTIVITY-ROTATION RELATIONS FOR LOWER MAIN SEQUENCE STARS Ph.D. Thesis
Andrea Kay Dobson-Hockey 1987 154 p
Avail: Univ. Microfilms Order No. DA8801623

It was known for some time that stellar rotation and activity are related, both for chromospheric activity and control activity. Younger, more rapidly rotating stars of a given spectral type generally show higher levels of activity than do older, more slowly rotating stars. On the Sun acitivity is distinctly related to magnetic fields. This leads to the suggestion that activity, at least in solar-type stars, is traceable to a magnetic dynamo which results from the interaction of rotation and differential rotation with convection. The more efficient the coriolis forces are at introducing helicity into convective motions, the more the magnetic field will be amplified and the more activity that is expected. The precise nature of the relationship between magnetic fields, rotation, and activity remains to be well-defined. It is the purpose to examine the relationship between activity and rotation in order to better define and express such a relation (or relations). To meet this goal, a comprehensive sample of stars was collected from the published literature having two or more of the following: chromospheric Ca II, H, and K emission indices; coronal soft X-ray illumination; rotation rates; and where possible, ages. It is seen that the use of normalized activity units and Rossby number generally improves the correlation between activity and rotation. The use of the convective turnover time further permits a possible explanation for the distribution of stars in an activity-color diagram. A large and homogeneous data set permits better definition of previously examined functional dependencies such as the time decay of activity and the relationship between chromospheric and coronal activity indicators.
Dissert. Abstr.

N88-29641 Michigan Univ., Ann Arbor.
AN UPPER LIMIT ON THE PRIMORDIAL He4 ABUNDANCE FROM SPECKLE INTERFEROMETRIC OBSERVATIONS OF MUON CASSIOPEIAE Ph.D. Thesis
James William Haywood 1987 103 p
Avail: Univ. Microfilms Order No. DA8801330

The intermediate Population 2 astrometric binary star mu Cassiopeiae was resolved using a CCD camera and the technique of speckle interferometry. Observations were made at 810 and 858 nm, at 4 epochs between 1983.7 and 1985.9. The masses of the components of mu Cassiopeiae can be calculated using the parameters of the two most recently published astrometric orbits. The parameters of these orbits are in good agreement for all parameters except omega. The masses calculated using the parameters from these orbits are not in agreement. The values of omega determined from the fits for the orbits are in agreement. The temperature of the secondary and the difference in bolometric magnitude between the secondary and primary are calculated using the reported intensity differences at various wavelengths, including those obtained from this study, and the temperature of the primary. Since the primary is massive enough that it will have evolved off the main sequence, the helium abundance of the primary is calculated for a number of assumed ages. By calculating the helium abundance of the secondary, the age of the system can be determined from the primary. At present, the errors on the helium abundance and age derived by this method are too large for them to provide any useful information. Dissert. Abstr.

N88-29642# Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics.
CLUSTERING OF GALAXIES AND CLUSTERS OF GALAXIES IN A DECAYING-PARTICLE COSMOLOGICAL MODEL WITH A MASSIVE DECAY PRODUCT
Kenji Tomita Jan. 1988 46 p
(DE88-753434; RRK-88-2) Avail: NTIS (US Sales Only) HC A03/MF A01

Based on a decaying-particle cosmological model with a massive decay product whose present Jeans wavelength is approximately 30/h Mpc (the Hubble constant H(sub 0) = 100 h/kms/Mpc), we study the correlation functions and velocity distributions of galaxies and clusters of galaxies using the direct method of N body simulation for these objects and the simple difference method for the dark matter fluid consisting of the decay product. It is assumed that the index N(sub s) of the initial density perturbations is 0, -1 and -2, the redshift z(sub d) corresponding to the decay time is 2 approximately 3 and the present density parameter omega(sub 0) for the decay product is 0.8 approximately 0.9. The dark matter fluid prevents galaxies from clustering in the small-scale and helps clusters of galaxies clustering in the large-scale. Owing to this role of the dark matter fluid, models in

the case N(sub s) = 0 approximately -1, zeta(sub 0) = 0.8 approximately 0.9 and z(sub d) = 2.0 approximately 3.0 are found to be consistent with the observational results on the correlation functions and velocity distributions. DOE

N88-29643 City Univ. of New York, N.Y.
RESONANCE EXCITATION OF LINEAR AND NON-LINEAR SPIRAL DENSITY WAVES IN A GASEOUS DISK Ph.D. Thesis
Ye Cheng 1987 168 p
Avail: Univ. Microfilms Order No. DA8801691

The theory of linear and nonlinear density and/or acoustic waves in a gaseous disk responding to a periodic perturbational force, such as that caused by a satellite in a ring system, or by a rotating mass distortion in the central region of a galaxy is developed. Based on the nonlinear formulation devised by Shu, Yuan and Lissauer (1985), we rederive a fundamental integro-differential equation with the inclusion of all three factors: pressure, self-gravity, and viscosity. To apply this equation, physical parameters used in various astrophysics problems are examined and approximations justified. The amplitude relation and the dispersion relation indicate the appropriate replacement for the integro-differential equation by a nonlinear differential equation. These relations also describe the features of the excitation and propagation processes. A complete linear theory of density and/or acoustic waves with viscosity and self-gravity was worked out. The excitation mechanism by which the waves are generated in the gaseous disk was studied. The asymptotic solutions to the linearized equation which are presented along with the numerical solutions help to clarify several important aspects concerning the nature of the waves in a disk system. In an application to the 3 kpc arm problem in the Galaxy, the nonlinear differential equation was solved numerically with the aid of the linear solutions. It was found that an oval distortion of 5 percent of the mean gravitational field near the outer Lindblad resonance can generate a wave in a close resemblance to the observed 3 kpc arm. Dissert. Abstr.

N88-29644# Lawrence Livermore National Lab., Calif.
NON-LINEAR SCALE INVARIANCE IN A COLD-DARK-MATTER UNIVERSE
F. R. Bouchet 11 May 1988 7 p Presented at the 8th Moriond Astrophysics Meeting on Dark Matter, Les Arcs, France, 6 Mar. 1988
(Contract W-7405-eng-48)
(DE88-011725; UCRL-98784; CONF-8803113-1) Avail: NTIS HC A02/MF A01

The observed decomposition of the lowest (N = 3,4) N-point correlation functions in symmetrized (N - 1) products of two-point correlation functions suggest the possibility that the Universe may obey a specific scale invariance, at least in some range. Assuming that this scale invariance is strictly verified for all N, some specific predictions concerning the void probability function P(sub O), and more generally the count probabilities P(sub N), as well as the fractal dimensions of the system can be made. In this report, the authors investigate the possibility that the non-linear evolution in a CDM Universe indeed to such a scale invariance. DOE

N88-29645 Durham Univ. (England).
MOLECULAR HYDROGEN IN GALAXIES Ph.D. Thesis
David Adam Wilkinson 1987 285 p
Avail: Univ. Microfilms Order No. BRD-80338

The key role played by molecular hydrogen in the evolution of galaxies is studied with a view to constraining its radial distribution in the Galaxy and the CO yields H sub 2 conversion factor alpha sub 20. The star formation rate is shown to be correlated with the surface density of H sub 2. A correlation between the molecular hydrogen fraction and the metallicity of a region allows the time evolution of H sub 2 to be described. This leads to a modified Schmidt Law of the SFR which explains quite naturally the production of galactic metallicity gradients and the constancy of the SFR in the absence of infall. A consistent closed model of the chemical evolution of the Galaxy is proposed to solve the G-dwarf problem, the stellar age-metallicity relation and the metallicity gradient, leading to the prediction of some initial amount of pre-disc processing of gas into visible and dark matter. The production of metallicity gradients in spiral galaxies is shown to be a direct consequence of the radial variation of the total surface density of matter and the age of the disc. The role of molecular gas in the evolution of the Oort Cloud of comets is examined. The radial distribution of H sub 2 in the Galaxy is derived and shown to agree in the inner Galaxy with that derived from gamma ray analysis. In the solar neighborhood it was found that alpha sub 20 = 2.5 + or - 0.5 and evidence was presented that alpha sub 20 varies as a function of galactocentric radius and from galaxy to galaxy. Dissert. Abstr.

N88-29646 Yale Univ., New Haven, Conn.
SYSTEMATIC PROPERTIES OF CLUSTERS OF GALAXIES IN DIFFERENT COSMOLOGICAL SCENARIOS Ph.D. Thesis
Michael John West 1987 172 p
Avail: Univ. Microfilms Order No. DA8801667

Rich clusters of galaxies and their environs are studied using N-body simulations in comparison with observations to examine whether any of their properties are sensitive to the cosmogonic scenario which led to their formation, and thus, could be used to help constrain the allowable initial density fluctuations from which the presently observed large-scale structure of the universe might have arisen. Protoclusters are identified in large-scale cosmological simulations which represent a wide range of viable scenarios within the framework of the gravitational instability picture. Individual clusters are then resimulated with high resolution, and their systematic properties studied in detail. The density and velocity dispersion profiles of the simulated clusters are found to be quite similar, irrespective of the initial conditions. Other systematic properties which were examined include the shapes of clusters and their orientations with respect to the galaxy distribution on larger scales, the mass-radius relation for clusters, and subclustering within clusters and their environs. Several methods are presented for describing quantitatively the amount of substructure within clusters. Dissert. Abstr.

N88-29647 Manchester Univ. (England).
DYNAMICS OF INTERACTING GALAXIES Ph.D. Thesis
S. N. Huang 1987 200 p
Avail: Univ. Microfilms Order No. BRD-80216

The generation of stellar shells produced by the interaction between a parent and a light disk galaxy is examined. The simulation is a restricted three-body calculation using 2000 particles. Dissipationaless and dissipative dynamical models were used. In both cases, the results are discussed in relation to observations. Lifetimes of shells are discussed. The generation of ring galaxies produced by the galaxy-galaxy collision is investigated. The simulation is an N-body approach using 2000 particles. The target system is a realistic disk with a live halo, the intruder is of rigid Plummer potential and moves along a rectilinear orbit with constant velocity. Sixteen experiments were performed. The morphology of the rings formed in the simulation and dynamical aspects of some selected rings were investigated. The different effects of having a live halo and a rigid halo in the target system were examined. Lifetimes are estimated. The results are discussed in relation to the observations. Dissert. Abstr.

N88-29648 Wisconsin Univ., Madison.
THE KINEMATICS OF MILKY WAY HALO GAS Ph.D. Thesis
Blair D. Savage 1987 211 p
Avail: Univ. Microfilms Order No. DA8800352

Interstellar line data along lines of sight that extend beyond the galactic disk were examined in order to investigate the nature of the Milky Way halo gas. The primary objective of this research is to employ the additional kinematic information contained in the velocity profiles of high resolution ultraviolet absorption and 21 cm emission data toward a large sample of objects that lie in or beyond the halo of the galaxy. A detailed study of the kinematics of halo gas at high latitudes which includes the study of absorption toward objects with the absolute value of b is greater than 40 degrees is contained. The study of gas toward a larger sample of

stars at a range of galactic latitudes that includes the data from the surveys of Savage and Massa (1987) and Pettini and West (1982) is presented. Dissert. Abstr.

N88-29649# Innovative Systems, Ramey (Puerto Rico).
A STUDY OF MECHANISMS PRODUCING ASTROPHYSICAL JETS Final Report, 9 Jul. 1987 - 16 Mar. 1988
Kenneth C. Turner Mar. 1988 35 p
(Contract F04611-87-C-0048)
(AD-A194100; IS0001F; AFAL-TR-88-007) Avail: NTIS HC A03/MF A01 CSCL 03B

During this study, Innovative Systems review the current situation regarding astrophysical jets, with emphasis on their acceleration process. Jets on both galactic and stellar scales are contrasted, and a common geometrical model for these phenomena is presented. After the presentation of a number of currently puzzling problems, a two-year research program is outlined, the aim of which is to further understand the acceleration of material to relativistic velocities in nature on various scales. GRA

N88-29650# International Centre for Theoretical Physics, Trieste (Italy).
GRAVITATIONAL REDSHIFT OF SELF-GRAVITATING SYSTEMS OF DARK MATTER IN THE UNIVERSE
Yuanzhong Zhang and Kejian Jin Nov. 1987 10 p
(DE88-702688; IC-87/286) Avail: NTIS (US Sales Only) HC A02/MF A01

We assume that two kinds of fermions with different masses are included in dark matter of the universe. These fermions may form stable self-gravitating systems. Gravitational redshifts in the center of the systems were calculated and a maximum value (1.22) of the redshift was found. DOE

N88-29651# Heidelberg Univ. (West Germany). Naturwissenschaftlich-Mathematischen Gesamfakultaet.
MODELING OF A COMETARY DUST COMA Ph.D. Thesis [MODELLIERUNG EINER KOMETAREN STAUBKOMA]
Lutz Massonne 1987 134 p In GERMAN
(ETN-88-92980) Avail: NTIS HC A07/MF A01

The correlation between structures in the dust coma and comets and processes in the comet nucleus were investigated. A numerical model of the cometary dust coma was developed. Its allows the calculation of dust densities in the coma, and provides synthetic pictures which simulate the calculated spatial dust density distribution. The in situ measurements at comet Halley confirm the concept of this coma model, and show that a quick adaptation of the model parameters is possible and leads to a good description of the coma. ESA

N88-29652*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CATALOG OF OPEN CLUSTERS AND ASSOCIATED INTERSTELLAR MATTER
David Leisawitz Jun. 1988 294 p
(NASA-RP-1202; Rept-88B0152; NAS 1.61:1202) Avail: NTIS HC A13/MF A01 CSCL 03B

The Catalog of Open Clusters and Associated Interstellar Matter summarizes observations of 128 open clusters and their associated ionized, atomic, and molecular iinterstellar matter. Cluster sizes, distances, radial velocities, ages, and masses, and the radial velocities and masses of associated interstellar medium components, are given. The database contains information from approximately 400 references published in the scientific literature before 1988. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-29653*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
LABORATORY EVALUATION AND APPLICATION OF MICROWAVE ABSORPTION PROPERTIES UNDER SIMULATED CONDITIONS FOR PLANETARY ATMOSPHERES Semiannual Status Report, 1 Feb. - 31 Jul. 1988
Paul G. Steffes [1988] 37 p
(Grant NAGw-533)
(NASA-CR-182443; NAS 1.26:182443; SASR-9) Avail: NTIS HC A03/MF A01 CSCL 03B

In the first half of this grant year, laboratory measurements were conducted on the millimeter-wave properties of atmospheric gases under simulated conditions for the outer planet. Significant improvements in the current system have made it possible to accurately characterize the opacity from gaseous NH3 at longer millimeter wavelengths (7 to 10 mm) under simulated Jovian conditions. In the second half of the grant year, it is hoped to extend such measurements to even shorter millimeter-wavelengths. Further analysis and application of the laboratory results to microwave and millimeter-wave absorption data for the outer planets, such as results from Voyager Radio Occultation experiments and earth-based radio astronomical observations will be continued. The analysis of available multispectral microwave opacity data from Venus, including data from the most recent radio astronomical ovservations in the 1.3 to 3.6 cm wavelength range and newly obtained Pioneer-Venus Radio Occulatation measurements at 13 cm, using the laboratory measurements as an interpretative tool will be pursued. Author

N88-29654*# Lunar and Planetary Inst., Houston, Tex.
MEVTV WORKSHOP ON NATURE AND COMPOSITION OF SURFACE UNITS ON MARS
J. R. Zimbelman, ed., S. C. Solomon, ed., and V. L. Sharpton, ed. 1987 148 p Workshop held in Napa, Calif., 4-5 Dec. 1987
(NASA-CR-183075; NAS 1.26:183075; LPI-Contrib-88-05) Avail: NTIS HC A07/MF A01 CSCL 03B

Topics addressed include: SNC meteorites and their potential for providing information about the geochemical evolution of Mars; remote sensing; photogeological inferences of Martian surface compositions; and interactions of the surface with volatiles in either the surface or the atmosphere. For individual titles, see N88-29655 through N88-29703.

N88-29655*# Washington Univ., Seattle.
SURFACE COMPOSITION OF MARS: A VIKING MULTISPECTRAL VIEW
John B. Adams, Milton O. Smith, Raymond E. Arvidson, Mary Dale-Bannister, Edward A. Guinness, and Robert Singer (Arizona Univ., Tucson.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 13-15 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

A new method of analyzing multispectral images takes advantage of the spectral variation from pixel to pixel that is typical for natural planetary surfaces, and treats all pixels as potential mixtures of spectrally distinct materials. For Viking Lander images, mixtures of only three spectral end members (rock, soil, and shade) are sufficient to explain the observed spectral variation to the level of instrumental noise. It was concluded that a large portion of the Martian surface consists of only two spectrally distinct materials, basalt and palgonitic soil. It is emphasized, however, that as viewed through the three broad bandpasses of Viking Orbiter, other materials cannot be distinguished from the mixtures. Author

N88-29656*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A REVIEW: QUANTITATIVE MODELS FOR LAVA FLOWS ON MARS
S. M. Baloga *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 17-19 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The purpose of this abstract is to review and assess the application of quantitative models (Gratz numerical correlation model, radiative loss model, yield stress model, surface structure model, and kinematic wave model) of lava flows on Mars. These theoretical models were applied to Martian flow data to aid in establishing the composition of the lava or to determine other eruption conditions such as eruption rate or duration. Author

N88-29657*# Lunar and Planetary Inst., Houston, Tex.
THE HISTORY OF MARTIAN VOLCANISM DETERMINED FROM A REVISED RELATIVE CHRONOLOGY
Nadine G. Barlow *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 20-21 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The Mariner 9 and Viking images of the Martian surface revealed much evidence of volcanic activity, both from early in the planet's history and more recently. The morphology of volcanic features range from plains to a variety of constructs, known as paterae, tholii (domes), and mons (shields) calculation of the density of superposed impact craters allows determination of the ages of these features relative to each other and to other geomorphic features on the planet's surface. The relative plotting technique recently was used to revise the Martian relative chronology. Author

N88-29658*# Hawaii Univ., Honolulu. Planetary Geosciences Div.
MARS: NEAR-INFRARED COMPARATIVE SPECTROSCOPY DURING THE 1986 OPPOSITION
James F. Bell, III and Thomas B. McCord *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 22-24 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Near-infrared spectral observations of Mars during the 1986 opposition were performed at the Mauna Kea Observatory utilizing the University of Hawaii's 88 inch telescope. Spectra were obtained of several Martian locations using a continuously variable filter (CVF) spectrometer with a resolution of 1.25 percent. Spot-to-spot ratios were produced between spectra taken in different geological regions. Author

N88-29659*# Hawaii Univ., Honolulu. Planetary Geosciences Div.
MARS: SPECTRAL SIGNATURES SEEN AND UNSEEN
Diana L. Blaney, Patti A. Walsh, and Thomas B. McCord *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 25-27 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Intrepretation of Mars surface reflectance spectra and geochemical modeling of the surface material are different approaches to the same problem (determining the compositional nature and evolution of the surface of Mars). The degree to which these two approaches agree is studied. This study involves: current understanding of the reflectance of Mars, and reflectance spectra of proposed Mars constituents. Author

N88-29660*# Sandia National Labs., Albuquerque, N. Mex.
SELECTIVE WEATHERING OF SHOCKED MINERALS AND CHONDRITIC ENRICHMENT OF THE MARTIAN FINES
M. B. Boslough *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 28-30 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

In a recent paper, Boslough and Cygan reported the observation of shock-enhanced chemical weathering kinetics of three silicate minerals. Based on the experimental data and on those of Tyburczy and Ahrens for enhanced dehydration kinetics of shocked serpentine, a mechnaism is proposed by which shock-activated minerals are selectively weathered on the surface of Mars. The purpose of the present abstract is to argue on the basis of relative volumes of shocked materials that, as a direct consequence of selective weathering, the composition of the weathered surface units on Mars should be enriched in meteoritic material. Author

N88-29661*# Dartmouth Coll., Hanover, N.H. Dept. of Geography.
INTERCRATER PLAINS DEPOSITS AND THE ORIGIN OF MARTIAN VALLEYS
G. R. Brakenridge *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 31-33 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Detailed geological mapping of portions of the Thaumasia Fossae and Aeolis Quandrangles has documented several interesting relationships between valley development and local geology. Formation of the valley development was discussed. B.G.

N88-29662*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
WEATHERING OF SULFIDES ON MARS
Roger G. Burns and Duncan S. Fisher *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 34-36 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Pyrrhotite-pentlandite assemblages in mafic and ultramafic igneous rocks may have contributed significantly to the chemical weathering reactions that produce degradation products in the Martian regolith. By analogy and terrestrial processes, a model is proposed whereby supergene alteration of these primary Fe-Ni sulfides on Mars has generated secondary sulfides (e.g., pyrite) below the water table and produced acidic groundwater containing high concentrations of dissolved Fe, Ni, and sulfate ions. The low pH solutions also initiated weathering reactions of igneous feldspars and ferromagnesian silicates to form clay silicate and ferric oxyhydroxide phases. Near-surface oxidation and hydrolysis of ferric sulfato-and hydroxo-complex ions and sols formed gossan above the water table consisting of poorly crystalline hydrated ferric sulfates (e.g., jarosite), oxides (ferrihydrite, goethite), and silica (opal). Underlying groundwater, now permafrost contains hydroxo sulfato complexes of Fe, Al, Mg, Ni, which may be stabilized in frozen acidic solutions beneath the surface of Mars. Sublimation of permafrost may replenish colloidal ferric oxides, sulfates, and phyllosilicates during dust storms on Mars. Author

N88-29663*# Sheffield Univ. (England). Dept. of Geology.
MAPPING OF VOLCANIC UNITS AT ALBA PATERA, MARS
Peter Cattermole *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 37-39 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Detailed photogeologic mapping of Alba Patera, Northern Tharsis, was completed and a geologic map prepared. This was supplemented by a series of detailed volcanic flow maps and used to study the morphometry of different flow types and analyze the way in which the behavior of the volcano has changed with time and also the manner in which flow fields developed in different sectors of the structure. Author

N88-29664*# Peking Univ. (China).
AN INTRODUCTION TO THE HISTORICAL RECORDS OF CHINA ABOUT MARS
Shuyen Chang and Zhongliang Wu *In* Lunar and Planetary

Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 40-42 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

There is a large amount of information about Mars in the Chinese historical records across thousands of years. This information is briefly reviewed. B.G.

N88-29665*# Martin Marietta Aerospace, Denver, Colo. Planetary Sciences Lab.
ELEMENTAL COMPOSITION OF THE MARTIAN SURFACE
Benton C. Clark *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 4 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The Viking landers carried X-ray fluorescence spectrometers (XRFS) to the surface of Mars for direct in-situ measurements of the elemental composition of samples that could be acquired by the surface sampler scoops. A total of 21 samples at two landing sites were acquired and analyzed. In this review, the constraints imposed on the design and operation of the XRFS; the accuracy and precision limitations of XRF; and the interpretation of the results are discussed. The latter includes relevance of the investigation to Martian geological processes, SNC meteorites, the formation and history of Mars, and future mission objectives/capabilities. Author

N88-29666*# Lunar and Planetary Inst., Houston, Tex.
SUB-KILOMETER RAMPART CRATERS IN THE EQUATORIAL REGION OF MARS: POSSIBLE IMPLICATIONS FOR THE STATE AND DISTRIBUTION OF REGOLITH H2O
Stephen M. Clifford and Elizabeth Duxbury (Massachusetts Inst. of Tech., Cambridge.) *In its* MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 44-45 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

It was long suspected that Martian rampart crater ejecta morphology originates from an impact into a water or ice-rich crust. If the water-impact hypothesis is correct, then the occurrence of rampart craters at all latitudes, elevations, and in all types of terrain, implies that the distribution of regolith H2O on Mars is global. To test this hypothesis, the occurrence of rampart craters was examined at three locations within the latitude band of + or - 30 degrees (specifically, within the ridged plains unit covered by MC-18). The analysis indicates that while few in number, rampart craters with diameters smaller than 3 km are indeed present at several locations withing the equatorial region of Mars. This finding appears to have significant implications for the inferred state and distribution of subsurface H2O. A more comprehensive analysis of the occurrence of sub-kilometer rampart craters is currently underway. Author

N88-29667*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHEMICAL AND SPECTROSCOPIC CHARACTERIZATION OF A SUITE OF MARS SOIL ANALOGS
L. M. Coyne, A. Banin, J. B. Orenberg, G. C. Carle, S. Chang, and T. W. Scattergood (State Univ. of New York, Stony Brook.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 46-48 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The National Aeronautics and Space Administration has begun preparations for the flight of the Mars Observer Mission in the early 1990s. An advanced ground-based study is being conducted on a usefully limited suite of Mars Soil Analog Materials (MarSAM) intended to simulate the aeolian material covering the surface of Mars. A series of variably proportioned iron/calcium smectite clays were prepared from a typical montmorillonite clay using the Banin method. The effect of increasing iron on a diverse set of chemical and spectroscopic properties of the suite of clays is discussed. In order to chemically characterize the MarSAM and compare them with the Martian soil studied by Viking, the clays were analyzed for their major and minor elemental compositions by X-ray fluorescence and ion-coupled plasma techniques. It was concluded that the surface iron has a complex and hitherto uninvestigated impact on the catalytic and spectroscopic properties of clays and on the ability of these material to store energy. Author

N88-29668*# Geological Survey, Flagstaff, Ariz.
SMALL MARTIAN VALCANOES
Philip A. Davis and Kenneth L. Tanaka *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 49-50 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Various types of volcanoes were identified on Mars, mainly on the basis of qualitative morphologic criteria such as relief, circularity, summit craters, and alignment with structural trends. A survey of Viking Orbiter images is being conducted to identify possible candidates for Martian volcanoes. The topographic profiles of the selected Martian volcanoes that are currently being acquired will be compared with tabulated data for terrestrial and lunar volcanoes. Variation in volcanic style with age will also be examined. Author

N88-29669*# University of Northeast Louisiana, Monroe. Dept. of Geosciences.
THE MARTIAN SEDIMENTARY RECORD
R. A. DeHon *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 51-53 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The differences between the surface geology of Mars and earth are discussed. Sedimentary processes and fluvial systems on Mars are examined. Surface mapping reveals the more recent depostional patterns. In future missions, radar sounding, active seismic systems, and on site deep drilling may be required to fully document the depositional history. For the present, identification of sedimentary layers must rest on localities of tectonic or erosional windows, detection of buried surfaces by indirect methods, and deposition or off lap patterns of distribution. Author

N88-29670*# University of Northeast Louisiana, Monroe. Dept. of Geosciences.
PROGRESS IN DETERMINING THE THICKNESS AND DISTRIBUTION OF VOLCANIC MATERIALS ON MARS
R. A. DeHon *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 54-56 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Volcanic plains and constructs comprise over half the surface of Mars. Volume estimates require sensible estimates of the thickness of volcanic materials. The completion of the 1:2 M Viking photomosaics and a refined geologic map based on Viking photography set the stage for improved thickness studies and volume estimates. Currently, a revised (but incomplete) data base of 740 partially buried craters was compiled using Mars photomosaics at 1:2 M for initial identification and measurement. Author

N88-29671*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY/NEUTRON SPECTROSCOPY FROM THE MARS OBSERVER
P. Englert, R. C. Reedy, D. M. Drake, W. C. Feldman, S. W. Squyres, L. G. Evans, and W. V. Boynton (Arizona Univ., Tucson.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 57-59 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The Gamma-Ray Spectrometer (GRS) experiment on Mars Observer will measure gamma rays and neutrons that escape from Mars. The intensities of gamma-ray lines and of the thermal and epithermal neutrons can be used to study many problems related

to Martian volcanism and volatiles. The results of theoretical calculations for the production and transport of gamma rays and neutrons indicate that the GRS should be able to determine the abundances of many elements and the amounts and stratigraphy of H2O and CO2 on and in the top meter of the Martian surface. Design considerations of the GRS are discussed. Author

N88-29672*# Lunar and Planetary Inst., Houston, Tex.
VARIABILITY IN SPECTRAL SIGNATURES OF TERRESTRIAL VOLCANIC ROCKS AND IMPLICATIONS FOR VOLCANOLOGY ON MARS
P. W. Francis *In its* MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 60-61 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The LANDSAT Thematic Mapper (TM) studies of 2.2 my old ignimbrites in a test area around the Cerro Galan Caldera, N. W. Argentina, show that the ignimbrites exhibit a remarkable range of spectral characteristics dependent both on intrinsic and extrinsic properties resulting from aeolian weathering processes. Spectral profiles of the ignimbrite in four contrasted environments were constructed using 6 TM bands. The textural and structural characteristics of ignimbrites on Mars were evaluated. Author

N88-29673*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AQUEOUS ALTERATION IN S-N-C METEORITES AND IMPLICATIONS FOR WEATHERING PRODUCTS ON MARS
J. L. Gooding *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 62-63 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Is shergottite, nakhlite, and chassignite (SNC) meteorites are rocks propelled to earth by large meteoroid impacts on Mars, then it is possible to deduce much about Martian igneous petrology and geochemistry. Because SNCs are igneous rocks, however, it was not obvious that they could reveal much about sedimentary and soil petrology and low-temperature geochemistry of Mars. It is important, though, that at least four of eight SNCs carry evidence for low-temperature, extraterrestrial weathering product phases. Evidence is reviewed for Martian weathering and alteration products in SNCs and possible inferences for volatile/regolith interactions, regolith mineralogy, and sinks for the putative hidden volatiles on Mars are outlined. Author

N88-29674*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
DISTRIBUTION AND TIMING OF THICK TRANSIENT AIR-FALL DEPOSITS IN ELECTRIS: IMPLICATIONS FOR THE NATURE OF THE UPLAND PLAINS
J. A. Grant and P. H. Schultz *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 64-66 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

A large area in the Electris region of Mars is (or once was) covered by an unconformable and etched deposit. Although interpreted as lava filling volcano-tectonic depressions or fluvial deposits filling large degraded craters, more recent work has shown the deposit is more likely the result of air-fall deposition. Crater densities on both the surface of the deposit and on exhumed, underlying ridged plains indicate that the deposit was emplaced and eroded over a relatively short time. These crater statistics also demonstate that the relative age of the Electris deposit is similar to those obtained for other unconformable deposits, thereby suggesting they may be related. Author

N88-29675*# Arizona State Univ., Tempe. Dept. of Geology.
PHOTOGEOLOGICAL INFERENCES OF MARTIAN SURFACE COMPOSITION
R. Greeley *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 67-68 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Photogeological mapping provides a systematic documentation of geologic observations and included the identification of surface materials and structures, and determination of their sequence of formation. It is concluded that photogeologic mapping shows the presence of a wide range of materials on Mars. Many of which appear to be volcanic. The knowledge of the composition of these materials is poorly constrained. Inferences drawn from the morphology of individual flows would suggest that most of the materials had rheological properties similar to basalt or other mafic magmas. B.G.

N88-29676*# London Univ. Observatory (England).
LAVA FLOW-FIELD MORPHOLOGY: A CASE STUDY FROM MOUNT ETNA, SICILY
J. E. Guest, J. W. Hughes, and A. M. Duncan (Luton Coll. of Higher Education, England) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 69-71 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The morphology of lava flows is often taken as an indicator of the broad chemical composition of the lava, especially when interpreting extraterrestrial volcanoes using spacecraft images. The historical lavas of the active volcano Mount Etna in Sicily provide an excellent opportunity to examine the controls on flow field morphology. In this study only flow produced by flank eruptions after the middle of the 18th century are examined. The final form of a flow-field may be more indicative of the internal plumbing of the volcano, which may control such factors as the effusion, rate, duration of eruption, volume of available magma, rate of de-gassing, and lava rheology. Different flow morphologies on Etna appear to be a good indicator of differing conditions within the volcanic pile. Thus the spatial distribution of different flow types on an extraterrestrial volcano may provide useful information about the plumbing conditions of that volcano, rather than necessarily providing information on the composition of materials erupted. Author

N88-29677*# Geological Survey, Flagstaff, Ariz.
HOW DIRTY IS MARS' NORTH POLAR CAP, AND WHY ISN'T IT BLACK
Hugh H. Kieffer *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 72-73 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Global studies of Mars seem to indicate conclusively that the seasonal polar caps are CO2, and that the residual polar cap is H2O. Viking Lander measurements are discussed, focusing on dust and water effects. The composition and annual budget of the residual caps and the local volatile transport should be well addressed by the complement of nadir-looking instruments on the Mars Observer. B.G.

N88-29678*# Houston Univ., Tex. Dept. of Geosciences.
SOME PROBABLE CHARACTERISTICS OF THE MARTIAN REGOLITH
Elbert A. King *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 74-75 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

A number of Mars surface environmental factors seriously affect the properties of the Martian regolith. The result is a regolith that is rather different from that of the moon. Some of the anticipated differences are discussed: weathering and lack of old glass; desert varnish; lack of micrometeorite impact products; abundance of meteorite fragments; and different grain size characteristics. Author

N88-29679*# Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
WHAT SNC METEORITES TELL US ABOUT MARTIAN MAGMATISM

John Longhi and Vivian Pan *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 76-78 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The SNC meteorites record relatively recent (less than b.y.) basaltic volcanism on a hydrous planet with a core. This much was known about Mars even before the Viking mission. The SNCs tell that the basalts were unusually low in Al2O3 and, despite overall similarities in major elements, apparently sampled two isotopically distinct regions of Mars: one is relatively depleted in incompatible elements (Nahklite source) with a U-Pb model age of 4.3 b.y. and is probably a portion of the upper Martian mantle, whereas the other is relatively enriched in incompatible elements (Shergottite source) with a 4.5 b.y. U-Pb age and is probably Martian crust assimulated into the mantle-derived Shergottite magma. The SNCs tell that the overall abundances of moderately volatile elements, such as alkalies, are higher on Mars than on earth. Given extensive volcanism and a depleted mantle, the present day absence of a thick atmosphere is more likely due to catastrophic removal of a primordial atmosphere than lack of degassing. Author

N88-29680*# Geological Survey, Flagstaff, Ariz.
SURFACE UNITS ON MARS: THE ASSEMBLAGE IN THE VALLES MARINERIS
B. K. Lucchitta *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 79-81 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The Valles Marineris system of troughs offers a unique opportunity to investigate Martian surface units in the third dimension. The troughs are more than 7 km deep in places and thus expose a significant portion of the Martian upper crust. The geological units within the Valles Marineris can be subdivided into three broad categories: wall rock, interior deposits, and surficial cover. Overall, the exposure units in the Valles Marineris give insights into surface units elsewhere on Mars. The observations tend to support the hypotheses that the highland material is charaged with ice, that some light-colored, rolling, smooth deposits are of volcanic origin, and that dark dunes and streaks are composed of wind blown mafic materials. Author

N88-29681*# Geological Survey, Flagstaff, Ariz.
MORPHOLOGIC CONTRASTS BETWEEN NIRGAL AND AUQAKUH VALLES, MARS: EVIDENCE OF DIFFERENT CRUSTAL PROPERTIES
David J. MacKinnon, Kenneth L. Tanaka, and Philip J. Winchell (Wittenberg Univ., Springfield, Ohio.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 82-84 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Photoclinometric measurements were made of sidewall slopes in Nirgal and Auqakuh Valles and these results were interpreted in terms of the geologic setting and a simple geomorphic model to provide insights into the physical properties of crustal materials in these areas. Nirgal was interpreted to be a runoff channel and Auqakuh to be a fretted channel. Geomorphologic arguments for the sapping origin of Nirgal and Auqakuh Valles were presented. The morphologies of the channels, however, differ greatly: the tributaries of Nirgal end abruptly in theater-headed canyons, whereas the heads of tributaries of Auqakuh shallow gradually. The plateau surface surrounding both channels appears to be covered by smooth materials, presumably lava flows; they are continuous and uneroded in the Nirgal area, but at Auqakuh they are largely eroded and several layers are exposed that total about 200 m in thickness. For Nirgal Valles, the measurements show that sidewalls in the ralatively shallow upper reaches of the channel have average slopes near 30 degrees and, in the lower reaches, sidewall slopes exceed 50 degrees. Auqakuh, on the other hand, has maximum sidewall slopes of 14 degrees and an approximate maximum depth of 1000 m. Faint, horizontal layering in portions of the lower reaches of Nirgal may indicate inhomogeneity in either composition or topography. Author

N88-29682*# Geological Survey, Flagstaff, Ariz.
GEOLOGY OF SIX POSSIBLE MARTIAN LANDING SITES
Harold Masursky, A. L. Dial, Jr., M. E. Strobell, and D. J. Applebee *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 85-87 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Thirteen detailed maps of the first six (of ten) possible sites for a future Lander/Rover/Sample-return mission to Mars are either nearing completion or in review. Basic mosaic of all sites were available at 1:2 million scale. In addition to preparing new base maps, special enhancements were generated for computer mosaics and individual images that delineate the geologic units more clearly. Photoclinometric profiles that allowed measurement of the thicknesses of geologic units, the depth of channels, and the throw on faults were prepared. Crater counts were made for each geologic unit. Author

N88-29683*# California Univ., San Diego, La Jolla. Space Inst.
SPECTRAL REFLECTANCE OF SNC METEORITES: RELATIONSHIPS TO MARTIAN SURFACE COMPOSITION
L. A. McFadden *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 88-90 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The spectral signatures of each of the Shergottite-Nakhlite-Chassignite (SNC) meteorite types measured to date are unique among extraterrestrial materials. Reflectance spectra of dark regions of Mars show evidence of basaltic composition. Analytic analysis of absorption band positions and widths in reflectance spectra of SNC meteorites will permit comparisons with spectra from approximately 600 km sized regions for which high-quality, near-IR spectra are available. Multi-spectral mapping data from orbital spacecraft is expected to provide the necessary spectra to determine basaltic compositions of smaller regions on Mars provided fresh, unaltered basalts can be observed or the effects of Martian weathering can be understood and removed from the spectra. With modeling of spectral weathering and mixing of SNC meteoritic assemblages it should be possible with the Mars Observer data to test for the presence of SNC analogs on the Martian surface. Before the relationship between the basaltic composition of units on Mars and the SNC meteorites can be addressed, it is necessary to analyze the absorption band parameters of the SNC reflectance spectra and to acquire high resolution spectral data on smaller regions of the Martian surface. Author

N88-29684*# Massachusetts Univ., Amherst. Dept. of Geology and Geography.
CONSTRAINTS ON THE ORIGIN OF FRACTURED TERRANE, NORTHERN MARTIAN PLAINS
George E. McGill *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 91-93 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The terrane characterized by giant fracture systems that commonly define crudely polygonal patterns has received much attention because of its potential importance to such diverse problems as the amount and distribution of interstitial volatiles on Mars, the source of the northern plains, and the tectonic evolution of the northern plains. Problems and constraints on proposed models are examined. B.G.

N88-29685*# Geological Survey, Menlo Park, Calif.
VIKING LANDERS AND REMOTE SENSING
H. J. Moore, B. M. Jakosky, and P. R. Christensen (Arizona State Univ., Tempe.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987

p 94-96 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Thermal and radar remote sensing signatures of the materials in the lander sample fields can be crudely estimated from evaluations of their physical-mechanical properties, laboratory data on thermal conductivities and dielectric constants, and theory. The estimated thermal inertias and dielectric constants of some of the materials in the sample field are close to modal values estimated from orbital and earth-based observations. This suggests that the mechanical properties of the surface materials of much of Mars will not be significantly different that those of the landing sites. Author

N88-29686*# Hawaii Univ., Honolulu. Planetary Geosciences Div.

VOLCANO EVOLUTION ON MARS

Pete Mouginis-Mark and Lionel Wilson *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 97-99 Prepared in cooperation with Lancaster Univ. (England) (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The diversity of volcanic activity on Mars throughout geologic time was one of the major factors that has controlled the spatial distribution of surface mineralogies. The traditional view of Martian volcanism is one in which effusive activity has dominated the entire preserved geologic history of the planet, with the minor exception of phreatomagnetic activity and associated volcano ground-ice interactions. However, two lines of evidence have caused reconsidering of this view, and have led to the possible role of explosive volcanism on Mars. First, detailed analysis of high resolution Viking Orbiter images has provided good evidence for explosive activity on Hecates Tholus and Alba Patera. Secondly, the problems believed to exist in associating explosive volcanism with silicic magmas on Mars, and the consequent unusual magmatic evolutionary trend for Martian volcanoes from silica-rich to silica-poor, may now be circumvented by the consideration of basatic plinian activity similar in kind to terrestrial eruptions such as the 1886 Tarawera eruption. The morphologic evidence for an early phase of explosive activity on Mars is briefly reviewed, and a model is presented for the emplacement of ash-flow deposits on Martian volcanoes. The volcanoes Alba Patera and Olympus Mons are considered in this context, along with some of the older Martian tholi and paterae Author

N88-29687*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ORIGIN OF NORTHERN LOWLAND PLAINS: CONSTRAINTS FROM BOUNDARY MORPHOLOGY

Timothy J. Parker and R. Stephen Saunders *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 100-102 (For primary document see N88-29654 23-91)
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The origin of the surface units of the northern lowland plains of Mars, about one third of the planet's surface, remains unclear after 20 years of analysis of spacecraft data. Hypotheses were put forward to explain the morphologies. The chief problem with constraining models of plains formation is that characterizing plains surface-forming processes is dependent upon the identification of distinctive landforms within the plains. The most commonly cited examples of distinctive morphologies found within the northern lowlands include: wrinkle ridges; small domes; giant polygons; and curvilinear ridges and ground undulations. To further constrain the processes involved, a careful analysis of boundary morphology is being conducted. Author

N88-29688*# Hawaii Univ., Honolulu. Planetary Geosciences Div.

EPISODIC VS. EPOCHAL RELEASE OF SO2 ON MARS

S. E. Postawko, F. P. Fanale, and A. P. Zent *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 101-102 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Erosion of the Martian surface by the flow of liquid water has apparently taken place at different times and locations on the planet. Many attempts were made to explain the valley networks by invoking a strong atmospheric CO2/H2O greenhouse early in the history of the planet. It was assumed that the large amounts of CO2 necessary to cause the greenhouse would have disappeared due to carbonate formation. Carbonates have yet to be positively identified. Volcanism has occurred throughout much of the history of Mars. Presumably gases such as SO2 were released along with CO2 and H2O. Estimates of amounts and rates with which SO2 were released into the Martian atmosphere, and how this would effect the global climate were made. Studies are continuing on the effects of SO2 and other volcanic gases on Martian climatic history. Author

N88-29689*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.

CHEMICAL INTERACTIONS BETWEEN THE PRESENT-DAY MARTIAN ATMOSPHERE AND SURFACE MINERALS Abstract Only

Ronald Prinn and Bruce Fegley *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 105 (For primary document see N88-29654 23-91)
(Grants NAG9-108; NSF ATM-87-10102)
Avail: NTIS HC A07/MF A01 CSCL 03B

Thermochemical and photochemical reactions between surface minerals and present-day atmospheric constituents are predicted to produce microscopic effects on the surfaces of mineral grains. Relevant reactions hypothesized in the literature include conversions of silicates and volcanic glasses to clay minerals, conversion of ferrous to ferric compounds, and formation of carbonates, nitrates, and sulfates. These types of surface-atmosphere interactions are important for addressing issues such as chemical weathering of minerals, biological potential of the surface environment, and atmospheric stability in both present and past Martian epochs. It is emphasized that the product of these reactions will be observable and interpretable on the microscopic surface layers of Martian surface rocks using modern techniques with obvious implications for sample return from Mars. Macroscopic products of chemical weathering reactions in past Martian epochs are also expected in Martian surface material. These products are expected not only as a result of reactions similar to those proceeding today but also due to aqueous reactions in past epochs in which liquid water was putatively present. It may prove very difficult or impossible however to determine definitively from the relic macroscopic product alone either the exact weathering process which led to its formation or the identity of its weathered parent mineral. The enormous advantages of studying Martian chemical weathering by investigating the microscopic products of present-day chemical reactions on sample surfaces are very apparent. Author

N88-29690*# Alaska Univ., Fairbanks.

STRATIGRAPHY OF THE KASEI VALLES REGION, MARS

Mark S. Robinson and Kenneth L. Tanaka (Geological Survey, Flagstaff, Ariz.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 106-108 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The thicknesses and geomorphology of the two principal stratigraphic units exposed in Kasei Valles to aid in interpreting the nature of crustal materials and the history of the channeling events in the area are identified and described. Previous studies of Kasei Valles have related the channel landforms to glacial flow, catastrophic flooding, and large-scale eolian erosion. The two units (an upper and a lower unit) form thick sheets, each having distinct geomorphologic features. Thicknesses of the unit were determined through preliminary stereogrammetric profiles taken across many sections of western Kasei Valles and shadow measurements taken

of scarp heights from calibrated Viking images having sun angles less than 25 degrees; DN values were examined to confirm that true shadows were observed. Author

N88-29691*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TOPOGRAPHY OF LARGE CRATERS ON MARS: IMPLICATIONS FOR THE HIGHLANDS RESURFACING HISTORY
L. E. Roth and R. S. Saunders *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 109-110 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The results of a point-by-point examination of the Goldstone topography data in the Martian highlands suggest that, at the 100 m range resolution, the rims of large craters are barely distinguishable against the surrounding terrain. Craters are described topographically. B.G.

N88-29692*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY ANALYSIS OF RECENT 2.2-4.2 MICROMETERS TELESCOPIC OBSERVATIONS OF ELYSIUM, MARS: IMPLICATIONS FOR CRYSTALLINITY AND HYDRATION STATE OF SURFACE MATERIALS
T. L. Roush, E. A. Roush, R. B. Singer, and P. G. Lucey (Hawaii Univ., Honolulu.) *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 111-113 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Comparisons of the telescopic reflectance spectrum of a Martian bright region, in the 2.2 to 4.2 micrometers region, with recent laboratory studies of materials in this same wavelength range are consistent with: terrestrial materials which are dehydrated relative to the terrestrial environment, and terrestrial materials which exhibit spectral behavior indicative of some degree of sample crystallinity which is greater than that of amorphous palagonites. This second conclusion is in agreement with recent suggestions concerning the Martian bright regions. However, additional laboratory research is required in order to constrain: the degree of crystallinity required to result in the 2.8 to 2.9 micrometers spectral behavior seen in the terrestrial samples, and the limit of crystalline material which can be accommodated in a mixture with measured telescopic data of Mars (0.3 to 4.2 micrometers). Author

N88-29693*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
ORIGIN OF SNC KAERSUTITIC AMPHIBOLE: EXPERIMENTAL DATA
M. J. Rutherford, Bruce Heine, and Marie Johnson *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 114-116 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The SNC meteorites, a group of cumulus textured, fine grained diabases, pyroxenites, and dunites, appear to have crystallized at relatively shallow depths on the same SNC parent body. Hydrous minerals generally are not present among the cumulus and intercumulus minerals in these meteorites except for some iddingsite alteration of olivine. The presence of hydrous magmatic amphibole in the SNC melt inclusions indicates that crystallization of the melt inclusions had to take place at significant pressure, probably greater than 1 kb based on previous amphibole stability data. If experimental data for kaersutite amphibole were to be obtained, it should be possible to estimate this pressure more precisely then previously, and to estimate the volatile (H2O) content of the parent magma. At this point, the factors controlling the chemistry and stability of high TiO2, kaersutitic amphiboles are not known. In an attempt to determine the factors which control the stability and chemistry of TiO2-rich amphibole, data was refined and extrapolated from four experimental studies of amphibole-melt equilibria recently completed. At the same time, hypothermal experiments were performed on a composition considered to be an early melt in the Shergotty magma liquid line of descent. The latter experiments were an attempt to reproduce crystallization of the amphibole-bearing melt inclusions. Author

N88-29694*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
EARLY CRATERING RATES AND THE NATURE OF THE MARTIAN CRATERED UPLANDS
P. H. Schultz *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 117-119 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The cratered uplands of Mars represent a complex sequence of reworked crater ejecta, distant basin ejecta deposits, sedimentary (aeolian and fluvial) deposits, and possible volcanic plains. The heritage of the early period of impact bombardment is documented in the preserved cratering record where the aereal density of large craters (greater than 20 km) exceeds that of the moon and subtle relicts of large impact basins remain. The cratering record provides a means to estimate the early impact flux on Mars, to constrain the direct and indirect effects of the impact process over various scales, and to evaluate the nature of the cratered upland surface materials. Four issues are addressed: the early Martian cratering rate; the role of late-stage atmospheric accretion of volatiles; the relative effects of craters and basins on the global redistribution of crustal materials; and the indirect longer term effects of basin formation. Author

N88-29695*# Geological Survey, Flagstaff, Ariz.
DOCUMENTING VOLCANO-TECTONIC EPISODES IN MARS' STRATIGRAPHIC RECORD
David H. Scott and Kenneth L. Tanaka *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 120-121 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Global geologic maps of Mars at 1:15,000,000 scales were digitized to obtain accurate measurements of the areal extent of 90 geologic units. These data were used to determine the resurfacing history of Mars by volcanic, eolian, fluvial, periglacial, and impact processes. This work is presently being extended to focus on the extent, magnitude, and duration of volcanism and tectonism (mainly faulting) throughout each of the three time-stratigraphic systems. This work involves detailed mapping to assess volcano-tectonic episodes in terms of their occurrence in eight epochs that represent subdivisions of Martian periods. Author

N88-29696*# Arizona Univ., Tucson. Lunar and Planetary Lab.
THE SURFACE COMPOSITION OF MARS FROM EARTHBASED OBSERVATIONS
R. B. Singer *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 122-124 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The current knowledge of the Martian surface from earth-based spectral reflectance observations, and what can (or can not) be determined from orbital reflectance and spectral imaging are discussed. Soils, dust, and primary crustal materials are briefly examined. B.G.

N88-29697*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MARS EARTH-BASED RADAR: 1986 RESULTS AND 1988-1990 OPPORTUNITIES
T. W. Thompson *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 125-126 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Earth's orbit around the sun is nearly circular, while the orbit of Mars is slightly elliptical. When earth-based radars observe Mars, the echo strength is proportional to the inverse fourth power of

the earth-Mars distance. Earth-based radar observations are done near oppositions. Radar echoes for the best oppositions near perihelion are about ten times stronger than the worst oppositions near aphelion. The results of previous observations and the possibilities for oppositions at perihelion (2001, 2003, and 2005) are discussed. Author

N88-29698*# Boston Univ., Mass. Dept. of Geology.
CRYSTAL FRACTIONATION IN THE SNC METEORITES: IMPLICATIONS FOR SURFACE UNITS ON MARS
Allan H. Treiman *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 127-128 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Almost all rock types in the SNC meteorites are cumulates, products of magma differentiation by crystal fractionation (addition or removal of crystals). If the SNC meteorites are from the surface of Mars or near sub-surface, then most of the igneous units on Mars are differentiated. Basaltic units probably experienced minor to moderate differentiation, but ultrabasic units probably experienced extreme differentiation. Products of this differentiation may include Fe-rich gabbro, pyroxenite, peridotite (and thus serpentine), and possibly massive sulfides. The SNC meteorites include ten lithologies (three in EETA79001), eight of which are crystal cumulates. The other lithologies, EETA79001 A and B are subophitic basalts. The cumulate lithologies ALHA77005 and EETA79001 C were not fully described or discussed. Author

N88-29699*# Hawaii Univ., Honolulu. Planetary Geosciences Div.
MARTIAN SURFACE ANALOGS: LABORATORY SPECTRAL STUDIES IN THE MID INFRARED
P. A. Walsh, D. L. Blaney, and T. B. McCord *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 129-131 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Ground-based telescopic reflectance spectra and analyses of Viking data have led to the conclusion that Martian surface fines are derived from a mafic to ultramafic source material, though the actual composition of these surface fines is still undetermined. A variety of possible compositions were proposed by several authors, however, with salts, particularly sulfates and carbonates, as important components in many of these models. Although salts are predicted components of the Martian surface, they are not identified in telescopic reflectance spectroscopic observations to date. One explanation for the absence of salts in these data is that they are not in quantities large enough to detect. This study was undertaken to determine the detectability of salts in various proposed Martian surface analog mixtures. This study concentrates on the carbonates and sulfate spectral features in the 2.5 to 25 micrometer spectral range because of recent work showing the usefulness of weak bands in the mid infrared for the remote sensing of particulate planetary surfaces. All measurements were made using a Nicolet 5SXC FTIR spectrometer with a bidirectional reflectance attachment, which uses an aluminum mirror as the background against which the sample is compared. Author

N88-29700*# San Jose State Univ., Calif. Dept. of Geology.
RIDGED AND GULLIED TERRAINS IN THE MARTIAN UPLANDS
D. E. Wilhelms and R. J. Baldwin *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 132-134 Prepared in cooperation with Geological Survey, Menlo Park, Calif. (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Two extensive types of geologic units in the Martian uplands are ridged plains and gullied (valley-network) terrain. The ridged plains, characterized by wrinkle ridges like those of the lunar maria, occupy depressions throughout the uplands. Gullied terrain is also widespread but is absent or rare in uplands dominated by plains or by large crater rims and basin rings. The ridged plains are rarely gullied but the gullied terrain and other upland terrain are commonly ridged. The relationship and origins of ridged plaines and gullied terrain are discussed. Author

N88-29701*# Houston Univ., Tex. Dept. of Geosciences.
VARIATION IN THE THICKNESS OF EJECTA COVER ON MARS WITH INCREASING CRATER DENSITY
A. Woronow *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 135-137 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

Even relatively young surfaces on Mars have superposed craters and must carry a dusting of impact debris. For increasingly more ancient surfaces, deposits of ejecta generally increase in thickness, and the signatures of the geology beneath become more obscured. Although nothing can be done about this obscuration, these newer deposits can be described, temporally and spatially, and thereby avoid falsely interpreting the geology beneath. The task of temporal and spatial characterization was begun by considering the areal variability of ejecta cover with increasing exposure to meteorite bombardment. This study establishes a baseline for evaluating the quality and distribution of exposures of strata lying temporally beneath the ejecta. Of special interest is the distribution of ejecta overlying surfaces that have never sustained a direct impact by a large meteorite, for these retain the volcanic and sedimentary stratigraphy in its most pristine state. Author

N88-29702*# Hawaii Univ., Honolulu. Planetary Geosciences Div.
COADSORPTION OF H2O AND CO2 ON THE MARTIAN SURFACE
A. P. Zent *In* Lunar and Planetary Inst., MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 138-139 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The adsorption of both CO2 and H2O was measured, under conditions of temperature and partial pressure similar to Mars, for a variety of absorbents. Both adsorb at coverages that exceed a monolayer at their respective Martian abundances. Clearly, their simultaneous presence in the Martian atmosphere will result in coadsorption of both at concentrations that may differ greatly from those measured during separate measurements. To the best of our knowledge, no data exists on the coadsorption of both gases. Co-adsorption experiments were begun and pertinent results will be reported. In the meantime the predicted behavior of such a system was mathematically explored as a compliment to the data, and to aid in its eventual interpretation. Author

N88-29703*# Lunar and Planetary Inst., Houston, Tex.
HIGH RESOLUTION VIKING ORBITER IMAGES: A USEFUL DATA SOURCE FOR TESTING THE VIABILITY OF GEOMORPHIC PROCESSES ATTRIBUTED TO MARTIAN LANDFORMS
James R. Zimbelman *In its* MEVTV Workshop on Nature and Composition of Surface Units on Mars 1987 p 140-142 (For primary document see N88-29654 23-91)
Avail: NTIS HC A07/MF A01 CSCL 03B

The diversity of landforms visible in the Viking images of Mars have led to a proliferation of geomorphic agents proposed to be active in shaping the Martian surface. While it is likely that numerous different processes have contributed to the geomorphology of Mars throughout Martian history, it is important that proposed Martian geomorphic agents be subjected to critical scrutiny by the scientific community. High resolution Viking Orbiter images represent a data set for investigating geomorphic processes on Mars. Geologic mapping of Mars can take place at a variety of scales, utilizing a variety of image resolutions, but an interpretation of the history of individual landforms is dependent upon the best available spatial resolution. These high resolution images provide the opportunity to examine proposed Martian geomorphic processes. It is clear that researchers may not interpret features in the same way but it is important that high resolution images of candidate features be

made available to the scientific community so that a consensus can be reached. This procedure can provide a way to refine the understanding of geomorphic processes on Mars. Author

N88-29704 California Univ., Los Angeles.
THE INTERACTION OF IO WITH THE PLASMA TORUS Ph.D. Thesis
Jon Andrew Linker 1987 370 p
Avail: Univ. Microfilms Order No. DA8802510

Io, Jupiter's innermost Galilean satellite, is perhaps the most intriguing satellite in the solar system. Spacecraft and ground-based observations have established that Io has an atmosphere, is a source of neutral particles, is volcanically active, and has associated with its orbit a dense, heavy ion plasma known as the Io plasma torus. Models and numerical simulation of the neutral and plasma environment near Io are developed. Models of the neutral density in Io's exosphere were also presented. The flow of the torus plasma past Io was examined by developing time-dependent global MHD simulations of the interaction. The simulations solve the nonlinear, compressible MHD equations self-consistently. The initial and boundary conditions are the only assumptions imposed. Two-dimensional and three-dimensional simulations were developed and include the effect of mass loading by ionization of neutrals in Io's exosphere. The Galileo spacecraft will pass through Io's wake in Io's equatorial plane. The data should make it possible to infer the amount of ionization occurring based on the effects seen in the wake. Dissert. Abstr.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N88-29705# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
NEUTRINO ELECTRODYNAMICS AND POSSIBLE EFFECTS FOR SOLAR NEUTRINOS
L. V. Okun, M. V. Voloshin, and M. I. Vysotskij 1986 26 p
(DE88-701647; ITEP-82(1986)) Avail: NTIS (US Sales Only) HC A03/MF A01

The matrix of electromagnetic moments of neutrinos and the possibility that some of the moments are as large as of the order of 10 to the 10th power of the Bohr magneton are discussed. Oscillations between neutrino flavors as well as neutrino spin precession in the presence of matter are considered. An interaction of solar neutrinos with the magnetic field existing in the convective zone inside the sun could give rise to the 11-year and semiannual cycles of variation of the measured solar neutrino flux in correlation with the solar activity. DOE

N88-29706# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PROMPT SIMULTANEOUS ACCELERATION OF PROTONS AND ELECTRONS TO RELATIVISTIC ENERGIES BY SHOCK WAVES IN SOLAR FLARES
Yukiharu Ohsawa and Jun-ichi Sakai Oct. 1987 27 p
(DE88-752553; IPPJ-851) Avail: NTIS (US Sales Only) HC A03/MF A01

It is shown by theory and fully relativistic, electromagnetic particle simulation that a collisionless fast magnetosonic shock wave can promptly accelerate protons and electrons to relativistic energies; proton energies are greater than or approximately 10(sup 9) eV and electron energies are greater than or approximately 10(sup 6) eV. The strong nonstochastic acceleration occurs in a rather strong magnetic field such that omega (sub ce) is greater than or approximate to omega (sub pe), where omega (sub ce) is the electron cyclotron frequency, and omega (sub pe) is the electron plasma frequency. The time needed for the proton acceleration is of the order of the ion cyclotron period and is quite short (much less than 1 s for solar plasmas). The electron acceleration time is shorter than the ion cyclotron period. The present shock acceleration mechanism can explain important features of observed particle acceleration in the impulsive phase of solar flares: simultaneous and prompt acceleration of protons and electrons to relativistic energies. DOE

N88-29707# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
RESONANT SPIN-FLAVOR PRECESSION OF SOLAR AND SUPERNOVA NEUTRINOS
Chong-Sa Lim and William J. Marciano (Brookhaven National Lab., Upton, N. Y.) Sep. 1987 22 p
(DE88-752604; INS-645) Avail: NTIS (US Sales Only) HC A03/MF A01

The combined effect of matter and magnetic fields on neutrino spin and flavor precession is examined. We find a potential new kind of resonant solar neutrino conversion Nu sub e(sub L) yields Nu sub Mu(sub R) or Nu sub tau(sub R) (for Dirac neutrinos) or Nu sub e yields Nu-bar sub Mu or Nu-bar sub tau or (for Majorana neutrinos). Such a resonance could help account for the lower than expected solar neutrino Nu sub e flux and/or indications of an anti-correlation between fluctuations in the Nu sub e flux and sunspot activity. Consequences of spin-flavor precession for supernova neutrinos are also briefly discussed. DOE

N88-29708*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
MORE THAN A SOLAR CYCLE OF SYNOPTIC SOLAR AND CORONAL DATA: A VIDEO PRESENTATION
J. T. Hoeksema, M. Herant, P. H. Scherrer, and A. M. Title Dec. 1987 12 p Presented at the 9th Sacramento Peak Summer Workshop on Solar and Stellar Coronal Structure and Dynamics, Sunspot, N. Mex., 17-21 Aug. 1987 Sponsored in part by Lockheed Independent Research Fund
(Grant NGR-05-020-559)
(NASA-CR-181459; NAS 1.26:181459; AD-A194603; CSSA-ASTRO-87-22) Avail: NTIS HC A03/MF A01 CSCL 03A

Color video movies of synoptic observations of the sun and corona can now be created. Individual analog frames on laser discs can be referenced digitally and played back at any speed. We have brought together photospheric magnetic field data from the Wilcox Solar Observatory at Stanford and the National Solar Observatory, model computations of the coronal magnetic field, and coronal data from the Sacramento Peak coronagraph and the Mauna Loa K-coronameter and made a series of movies presenting the data sets individually and in comparison with one another. This paper presents a description of each of the data sets and movies developed thus far and briefly outlines some of the more interesting and obvious features observed when viewing the movies. GRA

N88-29709 Institut d'Aeronomie Spatiale de Belgique, Brussels.
SHORT TERM VARIABILITY BETWEEN 120 AND 300 MM FROM SOLAR MESOSPHERE EXPLORER (SME) OBSERVATIONS
P. C. Simon, G. J. Rottman, O. R. White, and B. G. Knapp 1988 13 p Presented at the Solar Radiation Output Variations Workshop, Boulder, Colo., 9-11 Nov. 1987 Submitted for publication
(Aeronomica-Acta-A-328-1988; ISSN-0065-3713; ETN-88-92724) Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

Solar Mesosphere Explorer solar irradiance data was analyzed by fast Fourier transform (FFT) to isolate the solar flux modulation related to the 27-day solar rotation. The 27-day rotation period is confirmed as the dominant variation in time series of solar spectral irradiance. This feature is most pronounced at shorter wavelengths, especially Lyman-alpha, decreasing toward longer wevelengths. The FFT analysis reveals the amplitude of the 27-day variation in the data at all wavelengths, 120 to 300 nm, at all times between Jan. 1982 and Dec. 1986. ESA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N88-29710# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.

DIFFICULTIES WITH INTERPRETATION OF UNDERGROUND MUONS FROM CYGNUS X-3

V. S. Berezinskij, J. Ellis, and B. L. Ioffe 1986 27 p

(DE88-701645; ITEP-21(1986)) Avail: NTIS (US Sales Only) HC A03/MF A01

A possibility is analyzed to explain the underground muon flux detected from Cygnus X-3, using new particles (cygnets). The following constraints on the cygnet properties are obtained: on the life time tau is greater than 1.3 (sup 6) (gamma 10(sup s)) where gamma is the cygnet Lorentz factor, on the mass, m is less than 5.7 (E/100 TeV) GeV where E is the cygnet energy, on the electric charge Q is less than 2.10 (sup 7e) and on the mean scattering angle (due to an arbitrary process) on the way from Cygnus X-3 to the sun theta is less than 4.10 (sup -3) grad. It is shown that the NUSEX data (the angular spread of muons withing 10 (sup 0) box of observation and the dependence of the Cygnus X-3 exposition time on the depth of the matter along the observation line) contradict muon generation in the atmosphere and require muon generation in the ground. These data determine narrow boundaries for the cygnet-nucleon interaction cross-section 2 b is less than sigma is less than 10 b. The cross section low limit for the cygnet production in reaction pp yields CX is obtained from a constraint on the flux of underground muons generated by neutrinos: sigma(pp yields CX) is greater than 10 E(sub c)(1 TeV)(sup 1.1) b where E(sub c) is the energy of cygnets responsible for the muon flux observed by NUSEX. DOE

N88-29711 Durham Univ. (England).

VERY HIGH ENERGY COSMIC GAMMA RAYS FROM RADIO AND X-RAY PULSARS Ph.D. Thesis

Paula Mary Chadwick 1987 302 p

Avail: Univ. Microfilms Order No. BRD-80328

The detection of very high energy cosmic gamma rays from isolated pulsars and X-ray binary sources using the atmospheric Cerenkov techniques is investigated. A general introduction to gamma ray detection techniques is followed by a description of the properties of atmospheric Cerenkov radiation and a discussion of the principles of the atmospheric Cerenkov technique. The Mark 1 and 2 gamma ray telescopes operated in Dugway, Utah between 1981 and 1984 are briefly described. There follows a discussion of the results from observations at many different wavelengths of Cygnus X-3. The discovery of a 12.59 ms pulsar in data taken on Cygnus X-3 in 1983 is described. Evidence is presented which suggests this periodicity is also present at a weaker level in earlier data and also in the data taken in Durham in 1985. Results from observations of PSR1937 + 21, PSR1953 + 29 and six radio pulsars, are presented. The design and construction of the Mark 3 telescope, now operating in Narrabri, N.S.W., is described in detail. Preliminary results from observations with the Mark 3 telescope of three objects, LMC X-4, the Vela pulsar and Centaurus X-3, are presented. A brief discussion of the mechanisms by which VHE gamma rays may be produced in isolated pulsars and X-ray binary pulsars is given, followed by a description of the future prospects for the Mark 3 and Mark 4 telescopes. Dissert. Abstr.

N88-29712# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.

HADRONS PRODUCED IN ATMOSPHERIC INTERACTIONS

C. E. NaviaOjeda, R. H.C. Maldonado, H. M. Portella, F. A. Pinto, F. A. Pinto, and H. V. Pinto 1987 13 p

(DE88-702492; CBPF-NF-034/87) Avail: NTIS (US Sales Only) HC A03/MF A01

Systematic analysis is made on detected cosmic ray induced atmospheric interactions to study the hadron multiple production. It is demonstrated that hadron rich events are not characterized only by super families (halo events). About 5 percent of the events with visible energy in the range of 100 to 1000 TeV and transverse momentum density over the rapidity scale greater than or equal to 1 GeV km, has an anomalous hadron excess, already observed in super families (visible energy greater than 1000 TeV). The analysis did not include events identified as exotic ones (Centauro, Mini Centauro, Geminion and Chiron). DOE

99 GENERAL

N88-29713# European Space Agency, Paris (France).

FOCUS 86: A SUMMARY OF THE 1986 ANNUAL REPORT OF THE ACTIVITIES OF THE EUROPEAN SPACE AGENCY

Norman Longdon, comp. and Valerie David, comp. 1987 80 p Original contains color illustrations

(ESA-BR-34; ISSN-0250-1589; ETN-88-92777) Avail: NTIS HC A05/MF A01

European Space Agency science, Earth observation, microgravity, telecommunication, space transportation systems, and in-orbit infrastructure programs are summarized. Program support (satellite operations and data processing, ground facilities, technical infrastructure, information retrieval, program management) is described. ESA

N88-29714# Begeleidingscommissie Remote Sensing, Delft (Netherlands).

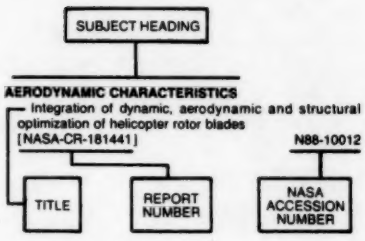
[ACTIVITIES REPORT IN REMOTE SENSING] Annual Report, 1986 [JAARVERSLAG 1986]

1986 104 p In DUTCH

(ETN-88-92905) Avail: NTIS HC A06/MF A01

The execution of the Dutch National Remote Sensing Program (NRSP) is reviewed. The NRSP projects are tabulated. Other projects, closely related to the NRSP, are mentioned. The tasks of the different groups within the NRSP are outlined, including radar investigation of water, vegetation, crop recognition, models, soil, and forest, as well as optical remote sensing of water and land. ESA

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7053).

A

ABSORPTION CROSS SECTIONS
Ultraviolet absorption cross sections of chloro- and chlorofluoromethanes at stratospheric temperatures
[AERONOMICA-ACTA-A-324-1988] N88-29228

ABSORPTION SPECTRA
The 1985-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599

ABUNDANCE
An upper limit on the primordial He4 abundance from speckle interferometric observations of muon Cassiopeiae N88-29641
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658

ACCELERATED LIFE TESTS
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042

ACCELERATION (PHYSICS)
A study of mechanisms producing astrophysical jets
[AD-A194100] N88-29649
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706

ACCELERATION TOLERANCE
Variation of carotid flow under load, studied by the Doppler echo method --- acceleration tolerance
[REPT-1149] N88-29282

ACCELEROMETERS
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240

ACCESS CONTROL
Formal specification of a secure document control system for SMITE
[RSRE-88002] N88-29309

ACCURACY
Aerodynamic data accuracy and quality: Requirements and capabilities in wind tunnel testing
[AGARD-AR-254] N88-28893

ACEE PROGRAM
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28928

ACID RAIN
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-008368] N88-29225

ACOUSTIC ATTENUATION
Experiments on the dissipation of sound by separated flow at an edge
[ISVR-TR-151] N88-29522
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523

ACOUSTIC LEVITATION
Combustion studies of acoustically suspended liquid droplets
[AD-A193892] N88-28998

ACOUSTIC PROPERTIES
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515

ACOUSTIC SCATTERING
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517

ACOUSTIC VELOCITY
Metal halide optical glasses
[AD-A193794] N88-29032

ACOUSTICS
Large aperture multi-dimensional laser radar testbed
[AD-A193447] N88-29155
Asymptotic modal analysis and statistical energy analysis
[NASA-CR-183077] N88-29514
ASKA-acoustics: Theory and applications --- vibro acoustics
[FFA-TN-1988-13] N88-29519
Overview of computational vibro acoustics. State of the art and future development
[FFA-TN-1988-17] N88-29521

ACOUSTO-OPTICS
Acoustic-optical detector of gravitational waves based on high-quality crystals
[DE88-702459] N88-29232

ACQUISITION
Artificial intelligence software acquisition program, volume 1
[AD-A194104] N88-29447

ACRYLATES
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027

ACTIVATION
The design of methane activation catalysts
[DE88-002265] N88-29043

ACTIVATION ENERGY
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027

ACTIVE CONTROL
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523

ACTS
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077

ACTUATORS
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system
[NASA-CR-178974] N88-28865
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29046
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194654] N88-29337

ADA (PROGRAMMING LANGUAGE)
Ada (trade name) compiler validation summary report: Verdix Corporation VAda-010-03205, version 5.42 MicroVAX 2 host and national DB32000 (NS32032 target
[AD-A193485] N88-29326
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335

ADAPTATION
Adaptive identification by systolic arrays
[AD-A193532] N88-29444
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems
[AD-A193560] N88-29464

ADAPTIVE CONTROL
Experimental investigations for the generation of phase modes for adaptive antennas
[REPT-10-87] N88-29074
Adaptive computational methods for aerothermal heating analysis
[NASA-CR-181636] N88-29115
Motion planning with obstacles and dynamic constraints N88-29175
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437
Computer-Aided-Control Engineering (CACE) primitives for robust and adaptive control systems, phase 1
[AD-A192448] N88-29439
Topics in adaptive control and inference
[AD-A194718] N88-29443
Adaptive identification by systolic arrays
[AD-A193532] N88-29444

ADAPTIVE FILTERS
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
Topics in adaptive control and inference
[AD-A194718] N88-29443

ADHESION
Dry adhesive friction of elastomers: A study of the fundamental mechanical aspects
[ETN-88-92903] N88-29036

ADHESIVE BONDING
A study of the floating roller peel test for adhesives
[AD-A194114] N88-29034

ADHESIVES
A study of the floating roller peel test for adhesives
[AD-A194114] N88-29034

ADSORPTION
Correlations between wettability and structure in monolayers of alkanethiols adsorbed on gold
[AD-A194348] N88-28991

ADSORPTIVITY
Coadsorption of H2O and CO2 on the Martian surface N88-29702

ADVANCED VERY HIGH RESOLUTION RADIOMETER
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250

AERIAL PHOTOGRAPHY
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis
[AD-A192399] N88-29208
AERODYNAMIC CHARACTERISTICS
Effects of independent variation of Mach and Reynolds numbers on the low-speed aerodynamic characteristics of the NACA 0012 airfoil section
[NASA-TM-4074] N88-28879
Aerodynamic data accuracy and quality: Requirements and capabilities in wind tunnel testing
[AGARD-AR-254] N88-28893
Technology for pressure-instrumented thin airfoil models
[NASA-CR-4173] N88-28933
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204
AERODYNAMIC CONFIGURATIONS
Delta wing configurations N88-28860
Complex configurations N88-28861
Transport-type configurations N88-28867
Combat aircraft N88-28868
Three dimensional grid generation for complex configurations: Recent progress
[AGARD-AG-309] N88-29313
Component adaptive grid generation for aircraft configurations N88-29316
Experience with three dimensional composite grids N88-29324
AERODYNAMIC LOADS
Unsteady flow past an NACA 0012 airfoil at high angles of attack
[AD-A194650] N88-28886
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
AERODYNAMIC NOISE
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883
AERODYNAMIC STALLING
E3 10C compressor test analysis of high-speed post-stall data
[NASA-CR-179521] N88-28929
AEROELASTICITY
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28928
AEROSOLS
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration
[AD-A193825] N88-29164
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987
[NASA-RP-1209] N88-29234
European validation of SAGE-2 aerosol profiles
[AERONOMICA-ACTA-A-327-1988] N88-29243
AEROSPACE ENVIRONMENTS
Optimization of low gravity materials processing experiments using expert systems N88-29361
AEROSPACE MEDICINE
Activities report in aerospace medicine
[ETN-88-92906] N88-29283
AEROSPACE SYSTEMS
Intelligent test integration system N88-29371
AEROSPACE VEHICLES
Knowledge-based fault diagnosis on future space vehicles N88-29374
AEROTHERMODYNAMICS
Adaptive computational methods for aerothermal heating analysis
[NASA-CR-181636] N88-29115
AGING (MATERIALS)
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042
AIR DEFENSE
Inflight rearming
[AD-A193564] N88-28909
Typical weather months in the past (1973-1983) in Central Europe
[AD-A194701] N88-29249
AIR FLOW
A numerical study of the test time in a hypersonic shock tunnel
[AD-A194057] N88-28888
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence
[FFA-TN-1988-02] N88-29126
AIR POLLUTION
The 1985-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226
AIR QUALITY
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-008366] N88-29225
AIR TO AIR MISSILES
Future air-to-air training for the RF-4
[AD-A194363] N88-29284
Approximations and implementations of nonlinear filtering schemes
[AD-A194685] N88-29462
AIR TO AIR REFUELING
Low altitude: A new dimension in air refueling
[AD-A193819] N88-28910
AIR TRAFFIC CONTROL
Fine resolution errors in secondary surveillance radar altitude reporting
[RSRE-87019] N88-28906
AIRBORNE EQUIPMENT
On experiences with two hot-wire instruments for measuring the liquid water content in clouds
[ESA-TT-1085] N88-29255
Airborne radar technology for windshear detection
[NASA-CR-183203] N88-29257
AIRBORNE/SPACEBORNE COMPUTERS
Computers in weapons systems: A look at the F-15
[AD-A194498] N88-28920
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194854] N88-29337
Knowledge-based fault diagnosis on future space vehicles N88-29374
An expert systems application to space base data processing N88-29384
AIRCRAFT ACCIDENTS
Smoke hoods: Net safety benefit analysis — aircraft accidents
[CAA-PAPER-87017] N88-28898
Visual related accidents/incidents N88-29293
AIRCRAFT CARRIERS
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS)
[NASA-CR-175104] N88-28917
AIRCRAFT COMPARTMENTS
Analysis of the transmission of sound into the passenger compartment of a propeller aircraft using the finite element method
[FFA-TN-1988-15] N88-29520
AIRCRAFT CONFIGURATIONS
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-28891
Three dimensional grid generation for complex configurations: Recent progress
[AGARD-AG-309] N88-29313
Lessons learned in the mesh generation for PN/S calculations N88-29314
Component adaptive grid generation for aircraft configurations N88-29316
Generation of multiple block grids for arbitrary 3D geometries N88-29317
Grid generation on and about a cranked-wing fighter aircraft configuration N88-29318
Grid generation for an advanced fighter aircraft N88-29319
Algebraic grid generation for fighter type aircraft N88-29320
Composite grid generation for aircraft configurations with the EAGLE code N88-29321
Analytical surfaces and grids N88-29322
Mesh generation for industrial application of Euler and Navier Stokes solvers N88-29323
Grid generation around transport aircraft configurations using a multi-block structured computational domain N88-29325
AIRCRAFT CONTROL
High performance forward swept wing aircraft
[NASA-CASE-ARC-11636-1] N88-28914
Variable wing camber control systems for the future Airbus program
[MBB-UT-104/88] N88-28932
AIRCRAFT DESIGN
Complex configurations N88-28861
Transport-type configurations N88-28867
Combat aircraft N88-28868
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task
[NASA-CR-3992] N88-28894
A contribution to the quantitative analysis of the influence of design parameters on the optimal design of passenger aircraft
[ETN-88-92979] N88-28912
Critical joints in large composite primary aircraft structures. Volume 2: Technology demonstration test report
[NASA-CR-172587] N88-28915
Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results
[NASA-CR-172588] N88-28916
Vision through aircraft transparencies N88-29294
AIRCRAFT ENGINES
AGARD engine disc cooperative test programme
[AGARD-R-766] N88-28926
AIRCRAFT LANDING
Additional investigations into the aircraft landing process: Test distributions
[ESA-TT-1099] N88-28913
AIRCRAFT MANEUVERS
Structural dynamics of maneuvering aircraft
[AD-A192376] N88-28908
Variation of carotid flow under load, studied by the Doppler echo method — acceleration tolerance
[REPT-1149] N88-29282
AIRCRAFT MODELS
Estimation of aircraft parameters using filter error methods and extended Kalman filter
[DFVLR-FB-88-15] N88-28911
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204
Analysis of the transmission of sound into the passenger compartment of a propeller aircraft using the finite element method
[FFA-TN-1988-15] N88-29520
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523
AIRCRAFT PERFORMANCE
High performance forward swept wing aircraft
[NASA-CASE-ARC-11636-1] N88-28914
AIRCRAFT STABILITY
High performance forward swept wing aircraft
[NASA-CASE-ARC-11636-1] N88-28914
AIRCRAFT STRUCTURES
Critical joints in large composite primary aircraft structures. Volume 2: Technology demonstration test report
[NASA-CR-172587] N88-28915
Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results
[NASA-CR-172588] N88-28916
Asymptotic modal analysis and statistical energy analysis
[NASA-CR-183077] N88-29514
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523
AIRFIELD SURFACE MOVEMENTS
Airport surface traffic automation study
[AD-A194553] N88-28934
AIRFOIL PROFILES
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110
Effects of precipitation on wind turbine performance
[DE88-001144] N88-29211
AIRFOILS
Computational tools for simulation methodologies N88-28865
Effects of independent variation of Mach and Reynolds numbers on the low-speed aerodynamic characteristics of the NACA 0012 airfoil section
[NASA-TM-4074] N88-28879
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883
Unsteady flow past an NACA 0012 airfoil at high angles of attack
[AD-A194650] N88-28886
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
AIRFRAMES
Crash simulation calculations and component idealization for an airframe. Computer code KRASH 79
[ETN-88-92971] N88-28899
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
AIRPORT PLANNING
Airport surface traffic automation study
[AD-A194553] N88-28934

ALGEBRA
Algebraic grid generation for fighter type aircraft
N88-29320
Composite grid generation for aircraft configurations with the EAGLE code N88-29321
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29467

ALGORITHMS
Time minimal computation of feedback control schemes for optimal guidance problems used in space flight
[ETN-88-92989] N88-28953
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058
Random-access algorithms for environments with capture
[AD-A194303] N88-29060
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064
Hierarchical organization for large, dynamic radio networks
[AD-A193942] N88-29067
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis)
[AD-A193580] N88-29117
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems
[AD-A193526] N88-29186
The gradient method for interface tracking
[AD-A194477] N88-29334
Some learnability results for analogical generation
[AD-A193669] N88-29342
An algorithm for determining the location of points in computer simulations
[AD-A193713] N88-29343
A fast parametric maximum flow algorithm, revision
[AD-A194026] N88-29345
Faster algorithms for the shortest path problem
[AD-A194031] N88-29347
Faster scaling algorithms for network problems
[AD-A194032] N88-29348
Analyst-centered models for systems design, analysis, and development N88-29364
Mathematical algorithms for approximate reasoning
N88-29418
Optimisation algorithms for highly parallel computer architectures. The performance of the truncated Newton, conjugate gradient algorithm in FORTRAN and Ada
[AD-A193940] N88-29435
The complexity of AI algorithms
[AD-A193494] N88-29438
MACSYMA program for the painleve test of nonlinear ordinary and partial differential equations
[AD-A194293] N88-29458
On Wiener-Masani's algorithm for finding the generating function of multivariate stochastic processes
[NASA-CR-182905] N88-29481
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan
[AD-A194357] N88-29495

ALLOCATIONS
Topics in adaptive control and inference
[AD-A194718] N88-29443

ALLOYS
Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni3Al
[DE88-702718] N88-29014

ALPHA PARTICLES
Measure of hydrogen concentration profile in materials by resonant nuclear reactions
[DE88-702599] N88-28999

ALTITUDE
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 1: Atomic ions (H(+), He(+), N(+), O(+))
[DFVLR-FB-88-11-PT-1] N88-29241

ALTITUDE ACCLIMATIZATION
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272

ALTITUDE SICKNESS
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272

ALUMINUM
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces
[DE88-004686] N88-29006
Relation between strength, creep and relaxation behavior in Cu and Al at room temperature
[ETN-88-92982] N88-29015
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92985] N88-29617

ALUMINUM ALLOYS
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193768] N88-29011
Passive damping concepts for free and forced member and grillage vibration
[NASA-CR-183114] N88-29196

ALUMINUM NITRIDES
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

ALUMINUM OXIDES
The high temperature creep deformation of Si3N4-6Y2O3-2Al2O3
[NASA-CR-183204] N88-28981
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986
Al2O3-TiO2 and Al2TiO5 ceramic materials
[SNIAS-881-430-122] N88-29038

AMORPHOUS SEMICONDUCTORS
Influence of the temperature-dependence of recombination life-time of free carriers in amorphous semiconductors on thermostimulated photocurrent spectra
[DE88-702728] N88-29609
Thermostimulated conductivity in amorphous semiconductors with non-exponential density of localized states
[DE88-702737] N88-29612

AMORPHOUS SILICON
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591

AMPHIBOLES
Origin of SNC kaersutitic amphibole: Experimental data N88-29693

AMPLITUDE MODULATION
Basic causes of amplitude modulation in climatic/weather parameters
[DE88-702743] N88-29254

ANALOGIES
Some learnability results for analogical generation
[AD-A193669] N88-29342

ANALYSIS (MATHEMATICS)
On a class of functionals invariant under a Z(sup n) action
[AD-A193474] N88-29451
Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179886] N88-29480

ANALYTIC FUNCTIONS
Holomorphic geometry of interacting string
[DE88-702714] N88-29627

ANGLE OF ATTACK
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-28891

ANGULAR MOMENTUM
Atmospheric angular momentum and length of day
[AD-A194505] N88-29238

ANIMALS
USAF hyperbaric animal transfer chamber system
[AD-A193633] N88-29265

ANNEALING
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591

ANNULI
Nonlinear elliptic problems with critical exponent in shrinking annuli
[W-87-02] N88-29477

ANTENNA ARRAYS
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066

ANTENNA DESIGN
Investigations on multiport antennas for polarimetric and modal field scanning
[REPT-5-87] N88-29073
Experimental investigations for the generation of phase modes for adaptive antennas
[REPT-10-87] N88-29074
Development of a multiport-hybrid-mode exciter for use in antennas for polarimetric field measurements
[REPT-12-87] N88-29075

ANTENNA RADIATION PATTERNS
Polynomials with restricted coefficients and their applications
[AD-A192589] N88-29055
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066

ANTENNAS
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276

ANTIFERROMAGNETISM
Static and dynamic behavior of a quasi one-dimensional Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a He3-He4 dilution refrigerator
[B8705564] N88-29533

ANTIMISSILE DEFENSE
SDI (Strategic Defense Initiative): A policy analysis
[AD-A194240] N88-29493
Strategic defense initiative architecture dataflow modeling technique version 1.5
[AD-A194356] N88-29494
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan
[AD-A194357] N88-29495
SDI (Strategic Defense Initiative). Where do we go from here
[AD-A194544] N88-29497
Nonlinear analysis of non-neutral plasmas
[AD-A192506] N88-29556

APERTURES
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276

APPROXIMATION
Stability of semidiscrete approximations for hyperbolic initial-boundary-value problems: Stationary modes
[NASA-TM-100994] N88-29455
Canonical forms in the control of DPS
[AD-A194671] N88-29461
Approximations and implementations of nonlinear filtering schemes
[AD-A194885] N88-29482
Finding minimum-cost circulations by successive approximation
[AD-A194028] N88-29489

APTITUDE
Validity of the academic aptitude composite of the Air Force Officer Qualifying Test (AFOQT)
[AD-A194753] N88-29286
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed
[AD-A193779] N88-29289

ARC HEATING
Numerical investigations in three-dimensional internal flows
[NASA-CR-183108] N88-29106

ARC JET ENGINES
Arcjet power supply and start circuit
[NASA-CASE-LEW-14374-1] N88-28939

ARCHITECTURE (COMPUTERS)
Method for Veterbi decoding of large constraint length convolutional codes
[NASA-CASE-NPO-17310-1-CU] N88-28948
Hierarchical organization for large, dynamic radio networks
[AD-A193942] N88-29067
Systolic array fault tolerance performance analysis
[AD-A193521] N88-29308
Nanosequencer digital logic controller
[NASA-CASE-NPO-16116-2] N88-29310
Solving the symmetric tridiagonal eigenvalue problem on the hypercube
[AD-A193905] N88-29344
Issues on the use of meta-knowledge in expert systems N88-29357
DAISY-DAMP: A distributed AI system for the dynamic allocation and management of power N88-29373

ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29390
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29391
Programming model for distributed intelligent systems N88-29390
Blackboard architectures and their relationship to autonomous space systems N88-29414
Validation of expert systems N88-29416
Semantic based man-machine interface for real-time communication N88-29421
Networking and AI systems: Requirements and benefits N88-29425
Expert system technology as a data processing tool N88-29427
A performance study of the hypercube architecture [AD-A194361] N88-29433
Optimisation algorithms for highly parallel computer architectures. The performance of the truncated Newton, conjugate gradient algorithm in FORTRAN and Ada [AD-A193940] N88-29435
Adaptive identification by systolic arrays [AD-A193532] N88-29444
Strategic defense initiative architecture dataflow modeling technique version 1.5 [AD-A194356] N88-29494

ARCTIC OCEAN
Sea ice processes [AD-A193980] N88-29262

ARCTIC REGIONS
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation [AD-A193958] N88-29068
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery [AD-A194732] N88-29250
Reflection and scattering of acoustic rays computed for parabolic ice keel models [AD-A193898] N88-29517

ARGON PLASMA
Modeling of atomic processes in X-ray laser plasmas [AD-A194118] N88-29567

ARIANE LAUNCH VEHICLE
Ariane 5, HERMES and European vehicles for space station servicing [SNIAS-881-422-102] N88-28943

ARMED FORCES (UNITED STATES)
Proposed improvements to the USAF flight screening program [AD-A194506] N88-29285
Validity of the academic aptitude composite of the Air Force Officer Qualifying Test (AFOQT) [AD-A194753] N88-29286
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed [AD-A193779] N88-29289
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation [AD-A193745] N88-29499

ARRAYS
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid [AD-A193594] N88-29088
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance [AD-A193815] N88-29143

ARTIFICIAL INTELLIGENCE
Motion planning for legged locomotion systems on uneven terrain N88-29170
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis [AD-A192399] N88-29208
Artificial intelligence applied to process signal analysis N88-29359
DAISY-DAMP: A distributed AI system for the dynamic allocation and management of power N88-29373
Intelligent resource management for local area networks: Approach and evolution N88-29385
Distributed cooperating processes in a mobile robot control system N88-29386
Programming model for distributed intelligent systems N88-29390
AI and simulation: What can they learn from each other N88-29391
Reasoning about fault diagnosis for the space station common module thermal control system N88-29395
Intelligent interface design and evaluation N88-29405
The concurrent common Lisp development environment N88-29422
AI tools in computer based problem solving N88-29424
Networking and AI systems: Requirements and benefits N88-29425
Radial basis functions, multi-variable functional interpolation and adaptive networks [RSRE-MEMO-4148] N88-29436
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437
The complexity of AI algorithms [AD-A193494] N88-29438
A model of information growth N88-29440
Artificial intelligence software acquisition program, volume 1 [AD-A194104] N88-29447
Design of a feeling-thinking machine [AD-A194107] N88-29448
Active explanation reduction: An approach to the multiple explanations problem [AD-A194127] N88-29501
Distributed knowledge base systems for diagnosis and information retrieval [AD-A193107] N88-29633

ARTIFICIAL SATELLITES
The 44/20 GHz ground terminal [AD-A194002] N88-29069

ASCENT TRAJECTORIES
Wind measurements by electromagnetic probes [NASA-TM-4066] N88-29256

ASTROMETRY
An upper limit on the primordial He4 abundance from speckle interferometric observations of muon Cassiopeiae N88-29641

ASTRONAUT MANEUVERING EQUIPMENT
Personnel occupied woven envelope robot N88-29408

ASTRONOMICAL MODELS
Clustering of galaxies and clusters of galaxies in a decaying-particle cosmological model with a massive decay product [DE88-753434] N88-29642
Molecular hydrogen in galaxies N88-29645
The interaction of Io with the plasma torus N88-29704

ASTRONOMICAL SATELLITES
Study of a safe attitude for the Infrared Space Observatory (ISO) during perigee pass [SNIAS-881-440-113] N88-28954

ASTRONOMY
Automated generation of spacecraft activity plans N88-29396
Catalog of open clusters and associated interstellar matter [NASA-RP-1202] N88-29652

ASTROPHYSICS
A study of mechanisms producing astrophysical jets [AD-A194100] N88-29649

ASYMMETRY
Three-dimensional vortex interactions [AD-A194066] N88-28889

ASYMPTOTIC METHODS
Thickness effects on the stability of shell like structures N88-29192
An asymptotic evaluation of the tail of a multiple symmetric alpha-stable integral [AD-A194570] N88-29460
Asymptotic modal analysis and statistical energy analysis [NASA-CR-183077] N88-29514

ATMOSPHERIC ATTENUATION
Evaluation of atmospheric effects for operational tactical decision aid [AD-A194205] N88-29236
European validation of SAGE-2 aerosol profiles [AERONOMICA-ACTA-A-327-1988] N88-29243

ATMOSPHERIC BOUNDARY LAYER
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation [AD-A193958] N88-29068

ATMOSPHERIC CIRCULATION
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system [PB88-190764] N88-29230
Atmospheric angular momentum and length of day [AD-A194505] N88-29238
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2 [DE88-010416] N88-29248

ATMOSPHERIC COMPOSITION
Atmospheric deposition of nitrate to the ocean surface N88-29227
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987 [NASA-RP-1209] N88-29234
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres [NASA-CR-182443] N88-29653

ATMOSPHERIC DENSITY
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements [AD-A194134] N88-29240

ATMOSPHERIC EFFECTS
Evaluation of atmospheric effects for operational tactical decision aid [AD-A194205] N88-29236

ATMOSPHERIC MODELS
Atmospheric deposition of nitrate to the ocean surface N88-29227
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 1: Atomic ions (H(+), He(+), N(+), O(+)) [DFVLR-FB-88-11-PT-1] N88-29241
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 2: Molecular ions (N2(+), NO(+), O2(+)) and electron density [DFVLR-FB-88-12-PT-2] N88-29242
Snapshots of high-latitude electrodynamics using Viking and DMSP/F7 observations [TRITA-EPP-88-01] N88-29244
Investigations on the entropy of cloudy air [ESA-TT-1060] N88-29245

ATMOSPHERIC REFRACTION
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation [AD-A193958] N88-29068

ATMOSPHERIC SOUNDING
European validation of SAGE-2 aerosol profiles [AERONOMICA-ACTA-A-327-1988] N88-29243

ATMOSPHERIC TEMPERATURE
Soot and radiation in a gas turbine combustor [AD-A191991] N88-28924

ATMOSPHERIC WINDOWS
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3 [AD-A194670] N88-29239

ATOMIC PHYSICS
Modeling of atomic processes in X-ray laser plasmas [AD-A194118] N88-29567

ATOMIC SPECTRA
Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum hydroxide [NASA-TT-20332] N88-29003
Modeling of atomic processes in X-ray laser plasmas [AD-A194118] N88-29567

ATOMIC STRUCTURE
Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni3Al [DE88-702718] N88-29014
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems [DE88-702060] N88-29576
Band electronic structures and crystal packing forces [DE88-010247] N88-29585

ATOMS
Soot and radiation in a gas turbine combustor [AD-A191991] N88-28924
Infrared detection using Rydberg atoms [AD-A194308] N88-29990
Cooperative effects and intrinsic optical bistability in collections of atoms [AD-A193993] N88-29530
Modeling of atomic processes in X-ray laser plasmas [AD-A194118] N88-29567

ATROPINE
Low doses of atropine sulfate impair retention of a well-learned spatial task [AD-A194065] N88-29266

ATTENTION
Visual motion perception and visual attentive processes [AD-A193640] N88-29288

ATTENUATION
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States [NASA-CR-179498] N88-29077

ATTENUATION COEFFICIENTS
Metal halide optical glasses [AD-A193794] N88-29032

ATTITUDE (INCLINATION)
Improvement of head-up display standards. Volume 2: Evaluation of head-up displays to enhance unusual attitude recovery
[AD-A194601] N88-28921
AUDITORY STIMULI
Human auditory and visual continuous evoked potentials N88-29269
AURORAS
Snapshots of high-latitude electrodynamics using Viking and DMSP/F7 observations
[TRITA-EPP-88-01] N88-29244
AUSTENITE
Kinetic of martensitic transformations induced by hydrogen in the austenite
[DE88-701623] N88-29007
AUTOMATA THEORY
A proof of the Kahn principle for input/output automata
[AD-A194454] N88-29333
The complexity of AI algorithms
[AD-A193494] N88-29438
AUTOMATIC CONTROL
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194654] N88-29337
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-86-62] N88-29352
Machine vision for real time orbital operations N88-29367
Automatic object recognition N88-29368
Failure modes and effects analysis automation N88-29370
A plan for time-phased incorporation of automation and robotics on the US space station N88-29377
Software development without languages N88-29392
Utilization of artificial intelligence techniques for the Space Station power system N88-29412
AUTOMATIC FLIGHT CONTROL
Automatic landing by computer vision
[ETN-88-92991] N88-28905
AUTOMATIC LANDING CONTROL
Automatic landing by computer vision
[ETN-88-92991] N88-28905
AUTOMATIC PILOTS
Low altitude: A new dimension in air refueling
[AD-A193819] N88-28910
AUTOMATIC TEST EQUIPMENT
Results of the use of an automated electrical measuring instrument calibration system
[SNIAS-881-430-107] N88-29146
AUTONOMY
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Knowledge elicitation for an operator assistant system in process control tasks N88-29366
Expert systems for MSFC power systems N88-29375
Blackboard architectures and their relationship to autonomous space systems N88-29414
AUTOREGRESSIVE PROCESSES
Strong law for mixing sequence
[AD-A193615] N88-29490
AVIONICS
Avionics system design for high energy fields: A guide for the designer and airworthiness specialist
[NASA-CR-181590] N88-28919
Aircraft avionics and missile system installation cost study. Volume 1: Technical report and appendices A through E
[AD-A194605] N88-28923
Avionic expert systems N88-29365
Contribution of expert systems to avionics advance. Application on AS30 laser weapon system
[SNIAS-881-320-103] N88-29449
AXIAL FLOW
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120
AXIAL STRESS
J-integral measurement using moire interferometry
[AD-A193751] N88-29202
AXISYMMETRIC FLOW
Fellowships in hypersonic aerodynamics
[AD-A194265] N88-28885
AZIDES (ORGANIC)
Polyazidoesters as energetic polymers and copolymer components with fluoro derivatives
[AD-A194236] N88-29039
AZIMUTH
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994

B

BACKGROUND NOISE
Effect of hypoxia on speech recognition in noise
[AD-A193943] N88-29280
BALL BEARINGS
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184
BALLISTICS
Proof-of-principle high speed electronic imaging system, phase 2
[AD-A193798] N88-28937
BALLOON FLIGHT
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230
BANACH SPACE
Critical values of functionals on Banach surfaces
[DE88-702735] N88-29472
BAND STRUCTURE OF SOLIDS
Study of superconducting properties in some many valley semiconductors
[DE88-702325] N88-29593
BANDPASS FILTERS
Computer aided filter design
[AD-A193959] N88-29093
Band pass with cavity resonators by use of three oscillation types
[ETN-88-92984] N88-29096
BARIUM COMPOUNDS
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR
[DE88-752611] N88-29588
BARIUM OXIDES
Effects of metal substitutions (Fe and Ga) in YBa2Cu3O7 on its superconducting properties and microstructures
[DE88-007393] N88-29572
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems
[DE88-702060] N88-29576
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583
BAYES THEOREM
Topics in adaptive control and inference
[AD-A194718] N88-29443
Selecting the best binomial population: Parametric empirical Bayes approach
[AD-A193341] N88-29450
Easy Bayes estimation for Rasch-type models
[AD-A193628] N88-29491
BEAM INJECTION
Pseudospark switches
[DE88-702227] N88-29085
Initial operation and edge plasma studies in ATF (Advanced Toroidal Facility)
[DE88-011400] N88-29562
BEAMS (RADIATION)
Beam optics test stand
[AD-A193901] N88-29144
BEHAVIOR
Elastic behavior of a rubber layer bonded between two rigid spheres
[AD-A193698] N88-29030
BENDING
Improved finite strip Mindlin plate bending element using assumed shear strain distributions
[NASA-TM-100928] N88-29195
BIAS
Two biased estimation techniques in linear regression: Application to aircraft
[NASA-TM-100649] N88-29489
BIBLIOGRAPHIES
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287
Multicriteria integer programming for problems involving linear and nonlinear utility functions
[AD-A194530] N88-29336
Topics in adaptive control and inference
[AD-A194718] N88-29443
BIHARMONIC EQUATIONS
Grid generation for an advanced fighter aircraft N88-29319
BINARY DATA
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
BINARY STARS
An upper limit on the primordial He4 abundance from speckle interferometric observations of muon Cassiopeiae N88-29641
BINOMIALS
Selecting the best binomial population: Parametric empirical Bayes approach
[AD-A193341] N88-29450
Relaxed heaps: An alternative to fibonacci heaps
[AD-A194030] N88-29470
BIODYNAMICS
Hierarchical structure in polymeric solids and its influence on properties
[AD-A194720] N88-29029
BIOLOGICAL EFFECTS
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
BIOMAGNETISM
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
Methods and instrumentation for biomagnetism
[AD-A193811] N88-29278
BISMUTH COMPOUNDS
Photorefractive damage mechanism in electro-optic materials
[AD-A194560] N88-29543
BLADE TIPS
Investigation of helicopter rotor blade/wake interactive impulsive noise
[NASA-CR-177435] N88-28882
BLADE-VORTEX INTERACTION
Investigation of helicopter rotor blade/wake interactive impulsive noise
[NASA-CR-177435] N88-28882
BLOOD CIRCULATION
Variation of carotid flow under load, studied by the Doppler echo method — acceleration tolerance
[REPT-1149] N88-29282
BODY MEASUREMENT (BIOLOGY)
Improvements in techniques of microwave thermography
[AD-A194613] N88-29062
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
BODY-WING CONFIGURATIONS
Analytical surfaces and grids N88-29322
BOLTED JOINTS
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
BONDING
Method for maintaining precise suction strip porosities
[NASA-CASE-LAR-13638-1] N88-29051
BORIDES
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
BORON COMPOUNDS
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
BOSONS
Open bosonic string in background electromagnetic field
[DE88-702140] N88-29053
The Hilbert space of the open bosonic string
[USIP-88-02] N88-29628
BOUNDARIES
Indian Ocean validation
[AD-A194458] N88-28902
BOUNDARY LAYER CONTROL
Boundary layer simulation and control in wind tunnels
[AGARD-AR-224] N88-28857
High-aspect-ratio wings N88-28859
Techniques for boundary layer tripping and control N88-28863
Environmental effects on transition and boundary layer characteristics N88-28876

A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112

BOUNDARY LAYER FLOW
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883

BOUNDARY LAYER SEPARATION
Missiles, fuselage and similar bodies N88-28858
Empirical tools for simulation methodologies N88-28866
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-28891

BOUNDARY LAYER STABILITY
Stability and drag reduction in a boundary layer with microbubbles
[AD-A191975] N88-29099
A singular perturbation analysis of the weakly nonlinear evolution of long and short water waves and waves in boundary layers N88-29102

BOUNDARY LAYER TRANSITION
Empirical tools for simulation methodologies N88-28866
Missiles, fuselages and similar bodies N88-28869
Introduction and critical flow phenomena N88-28870
Boundary layer development and transition N88-28871
Classical separation, trailing-edge flows and buffeting N88-28874
Environmental effects on transition and boundary layer characteristics N88-28876
Boundary layer manipulation N88-28877
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task
[NASA-CR-3992] N88-28894

BOUNDARY LAYERS
Shock boundary layer interaction N88-28873
Three-dimensional laser Doppler velocimeter studies of flow in a 90 deg curved duct having a square cross-section N88-29101
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29467

BOUNDARY LUBRICATION
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184

BOUNDARY VALUE PROBLEMS
The influence of numerical boundary conditions on transonic flow
[DFVLR-FB-88-06] N88-28890
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method
[AD-A193479] N88-29104
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191
Thickness effects on the stability of shell like structures N88-29192
Stability of semidiscrete approximations for hyperbolic initial-boundary-value problems: Stationary modes
[NASA-TM-100994] N88-29455
Canonical forms in the control of DPS
[AD-A194871] N88-29461
Stability and convergence in the numerical solution of stiff initial value problems
[B8681480] N88-29474
Nonlinear elliptic problems with critical exponent in shrinking annuli
[W-87-02] N88-29477
Elliptic equations with nearly critical growth
[W-87-16] N88-29478
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515

BRAIN
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
Methods and instrumentation for biomagnetism
[AD-A193811] N88-29278
Design of a feeling-thinking machine
[AD-A194107] N88-29448

BRAKES
Preloaded brake disc
[NASA-CASE-MSC-21132-1] N88-29181

BRANCHING (MATHEMATICS)
Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: Numerical and analytical results
[DE88-702747] N88-29473

BRAZING
Technology for pressure-instrumented thin airfoil models
[NASA-CR-4173] N88-28933

BREMSSTRAHLUNG
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165

BRIGHTNESS
Preliminary analysis of recent 2.2-4.2 micrometers telescopic observations of Elysium, Mars: Implications for crystallinity and hydration state of surface materials N88-29592

BROADBAND
On broadband matching of multiport electrical networks with applications
[AD-A194224] N88-29086

BROADBAND AMPLIFIERS
Wide band gyrotron traveling wave amplifier analysis
[AD-A194269] N88-29139

BUBBLES
Stability and drag reduction in a boundary layer with microbubbles
[AD-A191975] N88-29099
A multiple-scales partial solution of the pulse-forced Rayleigh-Plesset equation of cavitation bubble dynamics
[AD-A193733] N88-29118

BUFFETING
Classical separation, trailing-edge flows and buffeting N88-28874

BUOYANCY
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230

BUTADIENE
Polymerization of azaethylenes (imines) and aza-1,3-dienes: Potential reactive monomers
[AD-A194717] N88-29028

BUTANES
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027

C

CADMIUM TELLURIDES
Tunnelling currents in reverse biased CMT photodiodes
[RSRE-MEMO-4137] N88-29097

CALCIUM OXIDES
Nuclear magnetic ordering and paramagnetic relaxation of diatomic molecules in Ca (OH)2
[B8681469] N88-29532

CALCULUS
Practical higher-order functional and logic programming based on lambda-calculus and set-abstraction
[AD-A193845] N88-29466

CALCULUS OF VARIATIONS
On the distribution equations
[DE88-702217] N88-29454

CALIBRATING
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
Results of the use of an automated electrical measuring instrument calibration system
[SNIAS-881-430-107] N88-29146
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230

CAMERAS
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137

CAMOUFLAGE
Cleanability of aircraft polyurethane topcoats
[AD-A193456] N88-28878

CANONICAL FORMS
Canonical forms in the control of DPS
[AD-A194871] N88-29461

CANOPIES
Vision through aircraft transparencies N88-29294

CAPACITANCE
Ice detector
[NASA-CASE-LAR-13776-1] N88-29149

CAPACITORS
Stress corrosion of ceramic materials
[AD-A191979] N88-29016

CAPILLARY FLOW
Polymeric heat pipe wick
[NASA-CASE-GSC-13019-1] N88-29133

CARBON
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138

CARBON DIOXIDE
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2
[DE88-010416] N88-29248
Miniature respiratory sensor
[AD-A193430] N88-29300
Coadsorption of H2O and CO2 on the Martian surface N88-29702

CARBON FIBER REINFORCED PLASTICS
Nondestructive tests and high performance composite structures
[SNIAS-881-430-119] N88-28969

CARBON FIBERS
An investigation of some basic properties of hybrid composite materials
[AD-A194136] N88-28975

CARBON 12
Dispersion effects in elastic electron scattering from C12
[B8805297] N88-29536

CARBON-CARBON COMPOSITES
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
Spallation and dynamic fracture as an effect of laser induced shock-waves
[AD-A193513] N88-28971
Ultrafine microstructure composites prepared by chemical vapor deposition
[AD-A193849] N88-28973
Very high temperature materials for mechanical application
[SNIAS-881-430-106] N88-28978

CARBOXYL GROUP
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019

CARRIER MOBILITY
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
Temperature dependence of conductivity and of Hall coefficients for noble metal films
[ETN-88-92981] N88-29616

CASCADE FLOW
Modeling of momentum transport of axially parallel turbulent flows in rod cascades
[ETN-88-92978] N88-29131

CASCADE WIND TUNNELS
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936

CATALOGS
Catalog of open clusters and associated interstellar matter
[NASA-RP-1202] N88-29652

CATALYSTS
The design of methane activation catalysts
[DE88-002265] N88-29043

CATHODE RAY TUBES
Display system image quality N88-29298

CATIONS
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems
[DE88-702060] N88-29576

CATS
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267

CAUCHY PROBLEM
A limiting viscosity approach to the Riemann problem for materials exhibiting change of phase
[AD-A193477] N88-29103

CAVITATION FLOW
A multiple-scales partial solution of the pulse-forced Rayleigh-Plesset equation of cavitation bubble dynamics
[AD-A193733] N88-29118
An investigation of acoustic cavitation produced by pulsed ultrasound
[AD-A193523] N88-29516
Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547

CAVITIES
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-180484] N88-29116
Effects on the resonant frequencies caused by loading a spherical cavity with a dielectric sphere
[AD-A193864] N88-29511

CAVITY RESONATORS
Qualitative characteristics of open waveguide resonator spectra
[DE88-702387] N88-29056

Band pass with cavity resonators by use of three oscillation types
[ETN-88-92984] N88-29096
Free electron lasers with small period wigglers
[DE88-011627] N88-29156
CENTRAL EUROPE
Typical weather months in the past (1973-1983) in Central Europe
[AD-A194701] N88-29249
CENTRAL PROCESSING UNITS
Computers in weapons systems: A look at the F-15
[AD-A194498] N88-28920
CERAMIC MATRIX COMPOSITES
Very high temperature materials for mechanical application
[SNIAS-881-430-106] N88-28978
CERAMICS
Ultrafine microstructure composites prepared by chemical vapor deposition
[AD-A193849] N88-28973
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
Wave and fracture phenomena in impacted ceramics
[AD-A192948] N88-29020
Development of creep fracture modelling in ceramics
[PB88-202825] N88-29021
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024
The sol-gel synthesis of ceramics
[SNIAS-881-430-114] N88-29037
Al2O3-TiO2 and Al2TiO5 ceramic materials
[SNIAS-881-430-122] N88-29038
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
Development of planar geometry solid oxide fuel cell technology, phase 1
[PB88-210356] N88-29215
Electron microscopy of ceramic superconductors
[DE88-006446] N88-29580
Fluctuations of order parameters in the high T(sub c) superconductors
[DE88-702549] N88-29603
CERENKOV RADIATION
Diffraction transition radiation from periodic electron bunches
[AD-A193593] N88-29528
CHANNEL FLOW
Unsteady water channel
[AD-A194231] N88-28884
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method
[AD-A193479] N88-29104
CHANNELS (DATA TRANSMISSION)
Coding for meteor-burst communications channel and side information for channels with block-interference N88-29054
CHAOS
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis)
[AD-A193580] N88-29117
Chaotic behaviour in quantum dynamics
[AD-A193936] N88-29623
CHARGE COUPLED DEVICES
High performance charge transfer device detectors
[AD-A194409] N88-28993
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141
CHARGE DISTRIBUTION
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947
CHARGE TRANSFER
Applications of charge transfer devices in spectroscopy
[AD-A194408] N88-28992
CHARGE TRANSFER DEVICES
Applications of charge transfer devices in spectroscopy
[AD-A194408] N88-28992
High performance charge transfer device detectors
[AD-A194409] N88-28993
CHARGED PARTICLES
Difficulties with interpretation of underground muons from Cygnus X-3
[DE88-701645] N88-29710
CHEMICAL BONDS
Hydrogen storage by molecular polyhydrides
[AD-A194207] N88-28989
Potential induced structural transformations of the Au(100) and Au(111) surfaces
[DE88-005448] N88-29571
CHEMICAL CLEANING
Cleanability of aircraft polyurethane topcoats
[AD-A193456] N88-28878
CHEMICAL COMPOSITION
Surface composition of Mars: A Viking multispectral view N88-29655
Elemental composition of the Martian surface N88-29665
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676
How dirty is Mars' North Polar cap, and why isn't it black N88-29677
Some probable characteristics of the Martian regolith N88-29678
What SNC meteorites tell us about Martian magmatism N88-29679
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683
The surface composition of Mars from earthbased observations N88-29696
Martian surface analogs: Laboratory spectral studies in the mid infrared N88-29699
CHEMICAL LASERS
Frequency doubling at 1.315 micrometers
[AD-A193902] N88-29092
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow
[AD-A194479] N88-29162
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow
[AD-A194493] N88-29163
CHEMICAL PROPERTIES
Thermodynamic data bases for multivalent elements: An example for ruthenium
[DE88-004395] N88-28984
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595
Chemical and spectroscopic characterization of a suite of Mars soil analogs N88-29667
CHEMICAL REACTIONS
Theoretical investigations of nitrocubane decomposition
[AD-A194556] N88-29047
Method of dispensing reagent chemicals in space
[NASA-CASE-LAR-13607-1-CU] N88-29048
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595
CHEMICAL WARFARE
Advanced development waste processing unit for combat vehicles, phase 2
[AD-A193793] N88-29302
CHIPS (ELECTRONICS)
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
Reliability assessment of Surface Mount Technology (SMT)
[AD-A193758] N88-29089
CHIRAL DYNAMICS
Theoretical particle physics
[DE88-011499] N88-29521
CHLORINE
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193881] N88-28997
CHLOROCARBONS
Ultraviolet absorption cross sections of chloro- and chlorofluoromethanes at stratospheric temperatures
[AERONOMICA-ACTA-A-324-1988] N88-29228
CHOLINESTERASE
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266
CHROMIUM
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599
CIRCUIT BOARDS
Procedures for identification and handling of Printed Circuit Boards (PCBs)
[AD-A191177] N88-29078
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
CIRCUITS
Arcjet power supply and start circuit
[NASA-CASE-LEW-14374-1] N88-28939
Distortions in processed signals and their application in electronic design. Part 1: Basic and general formulations
[DE88-702731] N88-29070
Distortions in processed signals and their application in electronic design. Part 3: An automated generator of communication jamming signals
[DE88-702733] N88-29072
Power supply conditioning circuit
[NASA-CASE-NPO-17233-1-CU] N88-29095
CIRCULAR PLATES
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
CIRCULATION
Finding minimum-cost circulations by canceling negative cycles
[AD-A194027] N88-29488
Finding minimum-cost circulations by successive approximation
[AD-A194028] N88-29489
CLASSICAL MECHANICS
On the quantization of constrained generalized dynamics
[DE88-702223] N88-29505
CLASSIFICATIONS
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287
CLAYS
Chemical and spectroscopic characterization of a suite of Mars soil analogs N88-29667
CLIMATE
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-008368] N88-29225
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2
[DE88-010416] N88-29248
CLIMATOLOGY
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251
Episodic vs. epochal release of SO2 on Mars N88-29588
CLIMBING FLIGHT
Improvement of head-up display standards. Volume 2: Evaluation of head-up displays to enhance unusual attitude recovery
[AD-A194801] N88-28921
CLOSED CYCLES
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
CLOTHING
An investigation of some basic properties of hybrid composite materials
[AD-A194136] N88-28975
CLOUD PHYSICS
Investigations on the entropy of cloudy air
[ESA-TT-1080] N88-29245
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
CLOUDS
On experiences with two hot-wire instruments for measuring the liquid water content in clouds
[ESA-TT-1085] N88-29255
COAGULATION
Molecular composites processing and properties, 1
[AD-A194113] N88-28974
COASTS
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251
COATINGS
Thin film coatings for space electrical power system applications
[NASA-TM-101325] N88-28966
Thin film-residual stress assessment
[AD-A193205] N88-29018
The diamond as a new electronic material
[NASA-TT-20354] N88-29096
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515
COBALT 60
Evaluation of silicon-on-insulator MOS (Metal-Oxide-Semiconductor) transistor response to 10-keV X-ray and cobalt-60 irradiation
[DE88-006102] N88-29082
COCKPITS
Visual related accidents/incidents N88-29293

General operational and training visual concerns N88-29295
Night lighting and night vision goggle compatibility N88-29297
Future visual environment and concerns N88-29299
CODING
Fine resolution errors in secondary surveillance radar altitude reporting [RSRE-87019] N88-28906
Method for Veterbi decoding of large constraint length convolutional codes [NASA-CASE-NPO-17310-1-CU] N88-28948
Coding for meteor-burst communications channel and side information for channels with block-interference N88-29054
An overview of technology for spoken interaction with machines [AD-A194153] N88-29058
Hierarchical organization for large, dynamic radio networks [AD-A193942] N88-29067
A computer program package for introductory one-dimensional digital signal processing applications [AD-A194656] N88-29338
COEFFICIENTS
Polynomials with restricted coefficients and their applications [AD-A192589] N88-29055
COGNITION
Conjunctive measurement theory: Cognitive research prospects [AD-A193627] N88-29277
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed [AD-A193779] N88-29289
Expertise and reasoning with possibility: An explanation of modal logic and expert systems N88-29363
COHERENCE
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis) [AD-A193580] N88-29117
COLD WEATHER
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training [AD-A194777] N88-29274
COLLAGENS
Hierarchical structure in polymeric solids and its influence on properties [AD-A194720] N88-29029
COLLECTION
Cooperative effects and intrinsic optical bistability in collections of atoms [AD-A193993] N88-29530
COLLINEARITY
Two biased estimation techniques in linear regression: Application to aircraft [NASA-TM-100649] N88-29489
COLLISION AVOIDANCE
Fine resolution errors in secondary surveillance radar altitude reporting [RSRE-87019] N88-28906
UK airmisses involving commercial air transport [CAA-1/88] N88-28907
Airport surface traffic automation study [AD-A194553] N88-28934
On the collision hazard of colocated geostationary satellites [DFVLR-FB-88-02] N88-28952
COLLISION PARAMETERS
On the degenerate Ferrari-Ibanez solution for colliding plane gravitational waves [MATH-REPT-209] N88-29630
COLLOCATION
On the collision hazard of colocated geostationary satellites [DFVLR-FB-88-02] N88-28952
COLOR
Cleanability of aircraft polyurethane topcoats [AD-A193456] N88-28878
COMBAT
Future air-to-air training for the RF-4 [AD-A194363] N88-29284
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan [AD-A194357] N88-29495
COMBUSTION CHAMBERS
Numerical investigations in three-dimensional internal flows [NASA-CR-183108] N88-29106
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow [AD-A194479] N88-29162
COMBUSTION PHYSICS
Soot and radiation in a gas turbine combustor [AD-A191991] N88-28924
Combustion dynamics and thermal structure of a planar spray flame N88-28985
COMBUSTION STABILITY
Small scale mixing in the initial region of a jet [AD-A193500] N88-28994
COMETARY ATMOSPHERES
Modeling of a cometary dust coma [ETN-88-92980] N88-29651
COMMAND AND CONTROL
Distributed cooperating processes in a mobile robot control system N88-29386
Strategic defense initiative architecture dataflow modeling technique version 1.5 [AD-A194356] N88-29494
COMMERCIAL AIRCRAFT
Critical joints in large composite primary aircraft structures. Volume 1: Technical summary [NASA-CR-3914] N88-28983
COMMUNICATION
Coding for meteor-burst communications channel and side information for channels with block-interference N88-29054
An OKQPSK modem incorporating numerically controlled carrier synthesis [DE88-009536] N88-29304
Dynamic analysis of computer and communications sytems: Semi-Markov approach N88-29305
COMMUNICATION NETWORKS
Hierarchical organization for large, dynamic radio networks [AD-A193942] N88-29067
COMMUNICATION THEORY
DAISY-DAMP: A distributed AI system for the dynamic allocation and management of power N88-29373
COMPARISON
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2 [DE88-010416] N88-29248
COMPETITION
Competition: Issued on establishing and using Federally funded research and development centers [PB88-178884] N88-29632
COMPILERS
The SMITE modular compilation system [RSRE-MEMO-4145] N88-29307
Ada (trade name) compiler validation summary report: Verdix Corporation VAda-010-03205, version 5.42 MicroVAX 2 host and national DB32000 (NS32032 target [AD-A193485] N88-29326
A computer program package for introductory one-dimensional digital signal processing applications [AD-A194656] N88-29338
COMPLEX COMPOUNDS
Charge storage and switching phenomena in metal complexes [AD-A193778] N88-28996
Polymeric electrolytes [AD-A193766] N88-29031
COMPLEX VARIABLES
Polynomials with restricted coefficients and their applications [AD-A192589] N88-29055
COMPOSITE MATERIALS
Molecular composites processing and properties, 1 [AD-A194113] N88-28974
Microwave frequency nondestructive control [CERT-2/1355-MO] N88-28976
Finite Element Composite Analysis Program (FECAP) for a microcomputer [NASA-TM-100670] N88-28982
COMPOSITE STRUCTURES
Critical joints in large composite primary aircraft structures. Volume 2: Technology demonstration test report [NASA-CR-172587] N88-28915
Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results [NASA-CR-172588] N88-28916
Elastic wave dispersion in laminated composite plate [AD-A192289] N88-28967
Nondestructive tests and high performance composite structures [SNIAS-881-430-119] N88-28969
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation [AD-A193524] N88-28972
Critical joints in large composite primary aircraft structures. Volume 1: Technical summary [NASA-CR-3914] N88-28983
COMPRESSION LOADS
Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results [NASA-CR-172588] N88-28916
COMPRESSOR BLADES
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel [AD-A194737] N88-28936
COMPRESSORS
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program) [AD-A193678] N88-28925
E3 10C compressor test analysis of high-speed post-stall data [NASA-CR-179521] N88-28929
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall [AD-A194490] N88-29112
Reduction in mill air compressor power requirements through installation of a variable frequency speed control [DE88-008493] N88-29171
Development of the Simplified Compressor Model (SCM) for performance analysis of gaseous diffusion compressors [DE88-009066] N88-29173
COMPTON EFFECT
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551
COMPUTATION
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method [AD-A193479] N88-29104
Solving the symmetric tridiagonal eigenvalue problem on the hypercube [AD-A193905] N88-29344
The history of Martian volcanism determined from a revised relative chronology N88-29657
COMPUTATIONAL FLUID DYNAMICS
Boundary layer simulation and control in wind tunnels [AGARD-AR-224] N88-28857
Complex configurations N88-28861
Computational tools for simulation methodologies N88-28865
Empirical tools for simulation methodologies N88-28866
Transport-type configurations N88-28867
Combat aircraft N88-28868
Missiles, fuselages and similar bodies N88-28869
Introduction and critical flow phenomena N88-28870
Boundary layer manipulation N88-28877
An unsteady helicopter rotor: Fuselage interaction analysis [NASA-CR-4178] N88-28880
Accurate solutions, parameter studies and comparisons for the Euler and potential flow equations [NASA-TM-100664] N88-28892
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task [NASA-CR-3992] N88-28894
Steady and unsteady internal flow computations via the solution of the compressible Navier Stokes equations for low Mach numbers N88-29100
Three-dimensional laser Doppler velocimeter studies of flow in a 90 deg curved duct having a square cross-section N88-29101
Numerical investigations in three-dimensional internal flows [NASA-CR-183108] N88-29106
Navier-Stokes calculations of transonic flows past cavities [NASA-CR-180484] N88-29116
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows [AD-A193891] N88-29119
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence [FFA-TN-1988-02] N88-29126
European research program on viscous flows [DFVLR-AVA-IB-227-87-A-15] N88-29129
Three dimensional grid generation for complex configurations: Recent progress [AGARD-AG-309] N88-29313
Experience with three dimensional composite grids N88-29324
Overview of computational vibro acoustics. State of the art and future development [FFA-TN-1988-17] N88-29521
COMPUTATIONAL GRIDS
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1 [AD-A194166] N88-29110

Adaptive computational methods for aerothermal heating analysis
[NASA-CR-181636] N88-29115
Three dimensional grid generation for complex configurations: Recent progress
[AGARD-AG-309] N88-29313
Lessons learned in the mesh generation for PN/S calculations N88-29314
Three-dimensional elliptic grid generation for an F-16 N88-29315
Component adaptive grid generation for aircraft configurations N88-29316
Generation of multiple block grids for arbitrary 3D geometries N88-29317
Grid generation on and about a cranked-wing fighter aircraft configuration N88-29318
Grid generation for an advanced fighter aircraft N88-29319
Algebraic grid generation for fighter type aircraft N88-29320
Composite grid generation for aircraft configurations with the EAGLE code N88-29321
Analytical surfaces and grids N88-29322
Experience with three dimensional composite grids N88-29324
Grid generation around transport aircraft configurations using a multi-block structured computational domain N88-29325
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems
[AD-A193560] N88-29464

COMPUTER AIDED DESIGN
Structural dynamics of maneuvering aircraft
[AD-A192376] N88-28908
Computer aided filter design
[AD-A193959] N88-29093
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
Hologram representation of design data in an expert system knowledge base N88-29354
The use of computer graphic simulation in the development of robotic systems N88-29388
Computer-Aided-Control Engineering (CACE) primitives for robust and adaptive control systems, phase 1
[AD-A192446] N88-29439
Plasma torch design codes package
[SNIAS-881-430-115] N88-29569

COMPUTER AIDED MANUFACTURING
The use of computer graphic simulation in the development of robotic systems N88-29388
The concurrent common Lisp development environment N88-29422

COMPUTER GRAPHICS
Interactive, networked moving platform simulators
[AD-A192374] N88-28940
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204
The use of computer graphic simulation in the development of robotic systems N88-29388

COMPUTER INFORMATION SECURITY
The SMITE modular compilation system
[RSRE-MEMO-4145] N88-29307

COMPUTER NETWORKS
Process migration in UNIX environments
[NASA-CR-182951] N88-29311
Issues on the use of meta-knowledge in expert systems N88-29357
Intelligent test integration system N88-29371
Knowledge based programming environments: A perspective N88-29393
Two implementations of the Expert System for the Flight Analysis System (ESFAS) project N88-29400
Mathematical algorithms for approximate reasoning N88-29418
The concurrent common Lisp development environment N88-29422
Networking and AI systems: Requirements and benefits N88-29425
Radial basis functions, multi-variable functional interpolation and adaptive networks
[RSRE-MEMO-4148] N88-29436
Improved time bounds for the maximum flow problem
[AD-A194034] N88-29471

COMPUTER PROGRAMMING
ADP (Automated Data Processing) requirements definition and documentation through user-developed prototypes
[AD-A194407] N88-29332
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335
Analyst-centered models for systems design, analysis, and development N88-29364
Archetyping: A software generation and management methodology N88-29382
Programming model for distributed intelligent systems N88-29390
Knowledge based programming environments: A perspective N88-29393

COMPUTER PROGRAMS
Computers in weapons systems: A look at the F-15
[AD-A194498] N88-28920
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936
Evaluation of atmospheric effects for operational tactical decision aid
[AD-A194205] N88-29236
Atmospheric angular momentum and length of day
[AD-A194505] N88-29238
Electrochemical and optical studies of model photosynthetic systems
[DE88-009291] N88-29264
Process migration in UNIX environments
[NASA-CR-182951] N88-29311
Composite grid generation for aircraft configurations with the EAGLE code N88-29321
Waveform analysis on the IBM PC
[AD-A194249] N88-29330
OMV docking simulator N88-29379
Archetyping: A software generation and management methodology N88-29382
Generic supervisor: A knowledge-based tool for control of space station on-board systems N88-29389
Software development without languages N88-29392
Automated software development workstation N88-29423
Programming language concepts for multiprocessors
[AD-A193465] N88-29430
MACSYMA program for the painleve test of nonlinear ordinary and partial differential equations
[AD-A194293] N88-29458

COMPUTER STORAGE DEVICES
Programming language concepts for multiprocessors
[AD-A193465] N88-29430

COMPUTER SYSTEMS DESIGN
The SMITE modular compilation system
[RSRE-MEMO-4145] N88-29307
The SMITE object oriented backing store
[RSRE-MEMO-4147] N88-29308
Formal specification of a secure document control system for SMITE
[RSRE-88002] N88-29309
Computer systems for the representation and manipulation of mathematical knowledge
[AD-A193547] N88-29340
A software engineering approach to expert system design and verification N88-29356
Issues on the use of meta-knowledge in expert systems N88-29357
An approach to combining heuristic and qualitative reasoning in an expert system N88-29362
Expertise and reasoning with possibility: An explanation of modal logic and expert systems N88-29363
DAISY-DAMP: A distributed AI system for the dynamic allocation and management of power N88-29373
Requirements for a tool to aid in the development of expert systems for space station applications N88-29398
Life-span knowledge engineering for space operations N88-29401
Intelligent interface design and evaluation N88-29405
Design consideration in constructing high performance embedded Knowledge-Based Systems (KBS) N88-29415
A nonlinear filtering process diagnostic system for the Space Station N88-29417
A flexible search strategy for production systems N88-29420
Central user and browse service — ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637

COMPUTER SYSTEMS PERFORMANCE
DAISY-DAMP: A distributed AI system for the dynamic allocation and management of power N88-29373
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29381
Archetyping: A software generation and management methodology N88-29382
Benchmarking expert system tools N88-29399
A space station onboard scheduling assistant N88-29402
Intelligent interface design and evaluation N88-29405
Design consideration in constructing high performance embedded Knowledge-Based Systems (KBS) N88-29415
A flexible search strategy for production systems N88-29420

COMPUTER SYSTEMS PROGRAMS
Plasma torch design codes package
[SNIAS-881-430-115] N88-29569

COMPUTER TECHNIQUES
Automatic landing by computer vision
[ETN-88-92991] N88-28905
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194525] N88-28941
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
Approximate evaluation of semi-Markov chain reliability models
[AD-A194669] N88-29185
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems
[AD-A193526] N88-29186
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272
Failure modes and effects analysis automation N88-29370

COMPUTER VISION
Automatic landing by computer vision
[ETN-88-92991] N88-28905
Optimization-driven machine-oriented motion measurement N88-29312
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
Machine vision for real time orbital operations N88-29367
Two dimensional convolute integers for machine vision and image recognition N88-29369
A generic expert system for materials processing in space N88-29376

COMPUTERIZED SIMULATION
The influence of numerical boundary conditions on transonic flow
[DFVLR-FB-88-06] N88-28890
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis)
[AD-A193580] N88-29117
Free electron lasers with small period wigglers
[DE88-011627] N88-29156
Analysis of the hopfield neural networks and their application to pattern recognition
[AD-A193827] N88-29279
Three-dimensional elliptic grid generation for an F-16 N88-29315
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194654] N88-29337
An algorithm for determining the location of points in computer simulations
[AD-A193713] N88-29343
OMV docking simulator N88-29379
The use of computer graphic simulation in the development of robotic systems N88-29388
AI and simulation: What can they learn from each other N88-29391
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518
Stability experimental results of cable-in-conduit superconductor for fusion
[DE88-753424] N88-29589
The interaction of Io with the plasma torus N88-29704

COMPUTERS
Technical communication in the computer industry: An information-development process to track, measure and ensure quality N88-29635

CONCENTRATION (COMPOSITION)
Nonseismic, surface geophysical and geochemical prospecting technology
[PB88-196613] N88-29207

CONCURRENT PROCESSING
The concurrent common Lisp development environment N88-29422

CONDENSED MATTER PHYSICS
Nonlinear optical processes in molecular systems
[AD-A193871] N88-29546

CONDENSING
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193881] N88-28997

CONDUCTIVE HEAT TRANSFER
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
CONDUCTIVITY
Hydrogen concentration cells as converters of heat into electricity
[DE88-009662] N88-29216
CONDUCTORS
Conductor loss in superconducting power transmission cables
[DE88-011414] N88-29586
CONFERENCES
Visual Effects in the High Performance Aircraft Cockpit
[AGARD-LS-156] N88-29291
MEVTV Workshop on Nature and Composition of Surface Units on Mars
[NASA-CR-183075] N88-29654
CONFIDENCE LIMITS
Exact lower confidence limits for the reliability of k of n systems for zero failures and nonconservativeness of the maximus method
[AD-A194299] N88-29485
CONFIGURATION INTERACTION
An unsteady helicopter rotor: Fuselage interaction analysis
[NASA-CR-4178] N88-28880
CONFIGURATION MANAGEMENT
Intelligent resource management for local area networks: Approach and evolution N88-29385
Dynamically reconfigurable distributed database systems
[AD-A194716] N88-29636
CONFORMAL MAPPING
Distortion estimates for negative Schwarzian maps
[AD-A193172] N88-29209
CONNECTORS
Collet lock joint for space station truss
[NASA-CASE-MSC-21207-1] N88-29180
CONSERVATION EQUATIONS
Shock waves in unsteady flows
[NASA-TT-20329] N88-29134
CONSERVATION LAWS
Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments
[DE88-010202] N88-29329
CONSTANTS
Can we calculate the fundamental dimensionless constants of physics
[DE88-702641] N88-29625
CONSTRAINTS
Cooperating knowledge-based systems
[NASA-CR-183109] N88-29327
On recognizing ignorance N88-29372
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684
Origin of northern lowland plains: Constraints from boundary morphology N88-29687
CONSTRUCTION
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222
CONTAMINANTS
Blue-green laser diode research program
[AD-A191980] N88-29153
CONTINUOUS RADIATION
Analysis of free electron laser performance utilizing the National Bureau of Standards CW microtron
[AD-A194217] N88-29160
Static and dynamic behavior of a quasi one-dimensional Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a He3-He4 dilution refrigerator
[B8705564] N88-29533
CONTINUUM MECHANICS
The construction of the thermoelasticity equations on the basis of contemporary notions of nonlinear continua mechanics
[NASA-TT-20307] N88-29831
CONTINUUMS
Investigation of the higher-order elements in the SAMSON2 code
[AD-A193636] N88-29465
CONTOURS
Test results at transonic speeds on a contoured over-the-wing propfan model
[NASA-TM-86206] N88-28918
CONTROL SURFACES
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895
CONTROL SYSTEMS DESIGN
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Study on design and control of torque-controlled manipulators
[NASA-TT-20197] N88-29183
Distributed cooperating processes in a mobile robot control system N88-29386
Concepts for robot motion primitives required for space station teleoperations N88-29387
Generic supervisor: A knowledge-based tool for control of space station on-board systems N88-29389
Programming model for distributed intelligent systems N88-29390
Blackboard architectures and their relationship to autonomous space systems N88-29414
Real-time space system control with expert systems N88-29419
Computer-Aided-Control Engineering (CACE) primitives for robust and adaptive control systems, phase 1
[AD-A192446] N88-29439
CONTROL THEORY
Convex duality approach to the optimal control or diffusions
[AD-A194535] N88-29442
Canonical forms in the control of DPS
[AD-A194671] N88-29461
Minimizing escape probabilities: A large deviations approach
[AD-A194534] N88-29496
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r
[AD-A193510] N88-29506
CONTROLLERS
Motion planning with obstacles and dynamic constraints N88-29175
Nanosequencer digital logic controller
[NASA-CASE-NPO-16116-2] N88-29310
Artificial intelligence applied to process signal analysis N88-29359
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437
CONVECTION
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194246] N88-29237
CONVECTIVE HEAT TRANSFER
Estimation of transient heat transfer coefficients in multidimensional problems by using inverse heat transfer methods N88-29108
CONVERGENCE
Stability and convergence in the numerical solution of stiff initial value problems
[B8681460] N88-29474
CONVOLUTION INTEGRALS
Two dimensional convolute integers for machine vision and image recognition N88-29369
COOLING
High temperature electric arc furnace
[NASA-CASE-MFS-28281-1] N88-28938
Surface Tension Confined Liquid Cryogen Cooler (STCLCC)
[NASA-CASE-GSC-13112-1] N88-29050
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151
COOLING SYSTEMS
An experimental setup for the study of polarized He3 and dilute He3-He4 mixtures
[B8705589] N88-29001
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
COPOLYMERS
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027
Transport of organic vapors in multiphase polymer system
[AD-A194097] N88-29033
Polyazidoesters as energetic polymers and copolymer components with fluoro derivatives
[AD-A194236] N88-29039
COPPER
Relation between strength, creep and relaxation behavior in Cu and Al at room temperature
[ETN-88-92982] N88-29015
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR
[DE88-752611] N88-29588
Theoretical investigation of image states of the hydrogen covered Cu (100)
[DE88-702662] N88-29604
COPPER ALLOYS
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193768] N88-29011
COPPER OXIDES
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems
[DE88-702060] N88-29576
La2CuO(sub 4 + delta): A superconducting superoxide
[DE88-010325] N88-29578
CORIOLIS EFFECT
Activity-rotation relations for lower main sequence stars N88-29640
CORRELATION
Correlations between wettability and structure in monolayers of alkanethiols adsorbed on gold
[AD-A194348] N88-28991
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152
Mathematical correlation between variations in solar radiation parameters. Part 1: Daily sums of global radiation and midday global radiation
[DE88-702742] N88-29253
COSMIC DUST
Modeling of a cometary dust coma
[ETN-88-92980] N88-29651
COSMOLOGY
Cosmology in an N-dimensional vector space
[DE88-702550] N88-29507
Clustering of galaxies and clusters of galaxies in a decaying-particle cosmological model with a massive decay product
[DE88-753434] N88-29642
Systematic properties of clusters of galaxies in different cosmological scenarios N88-29648
COST ANALYSIS
Aircraft avionics and missile system installation cost study. Volume 1: Technical report and appendices A through E
[AD-A194805] N88-28923
A plan for time-phased incorporation of automation and robotics on the US space station N88-29377
Finding minimum-cost circulations by canceling negative cycles
[AD-A194027] N88-29468
Finding minimum-cost circulations by successive approximation
[AD-A194028] N88-29469
New developments in capital cost estimating
[DE88-005392] N88-29638
COST ESTIMATES
Aircraft avionics and missile system installation cost study. Volume 1: Technical report and appendices A through E
[AD-A194805] N88-28923
New developments in capital cost estimating
[DE88-005392] N88-29638
COUNTERMEASURES
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166
COUPLED MODES
Band pass with cavity resonators by use of three oscillation types
[ETN-88-92984] N88-29096
COUPLING
HPM (High-Power Microwave) coupling into realistic targets
[DE88-011788] N88-29084
CRACK INITIATION
AGARD engine disc cooperative test programme
[AGARD-R-766] N88-28926
Development of creep fracture modelling in ceramics
[PB88-202825] N88-29021
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193
CRACK PROPAGATION
AGARD engine disc cooperative test programme
[AGARD-R-766] N88-28926

Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
Development of creep fracture modelling in ceramics
[PB88-202825] N88-29021
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193
Results on the influence of crack tip plasticity during dynamic crack growth
[AD-A193460] N88-29194
Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels
[DE88-701619] N88-29198
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
J-integral measurement using moire interferometry
[AD-A193751] N88-29202

CRACK TIPS
Results on the influence of crack tip plasticity during dynamic crack growth
[AD-A193460] N88-29194

CRACKING (FRACTURING)
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program)
[AD-A193678] N88-28925
AGARD engine disc cooperative test programme
[AGARD-R-766] N88-28926
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201

CRACKS
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022

CRASHES
Crash simulation calculations and component idealization for an airframe. Computer code KRASH 79
[ETN-88-92971] N88-28899

CRASHWORTHINESS
Crash simulation calculations and component idealization for an airframe. Computer code KRASH 79
[ETN-88-92971] N88-28899

CRATERING
Early cratering rates and the nature of the Martian cratered uplands N88-29694

CRATERS
Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29686
Topography of large craters on Mars: Implications for the highlands resurfacing history N88-29691
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701

CREEP PROPERTIES
The high temperature creep deformation of Si3N4-6Y2O3-2Al2O3
[NASA-CR-183204] N88-28981
Development of creep fracture modelling in ceramics
[PB88-202825] N88-29021

CRITICAL FLOW
Introduction and critical flow phenomena N88-28870
Boundary layer development and transition N88-28871

CRITICAL TEMPERATURE
Dependence of high critical temperature of ceramic superconductors on the nominal Cu(sup 3+)Cu(sup 2+) ratio
[DE88-702734] N88-29611

CROSS FLOW
A numerical study of turbulent plane jets in still and flowing environments employing two-equation k-epsilon model N88-29109

CROSSED FIELDS
Vortex formation and particle transport in a cross-field plasma sheath
[DE88-008931] N88-29553

CROSSLINKING
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019

CRYOGENIC COOLING
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
Static and dynamic behavior of a quasi one-dimensional Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a He3-He4 dilution refrigerator
[B8705564] N88-29533

CRYOGENIC EQUIPMENT
Surface Tension Confined Liquid Cryogen Cooler (STCLCC)
[NASA-CASE-GSC-13112-1] N88-29050

CRYOGENIC WIND TUNNELS
Technology for pressure-instrumented thin airfoil models
[NASA-CR-4173] N88-28933

CRYOGENICS
LLE (Laboratory for Laser Energetics) review
[DE88-008065] N88-29158

CRYSTAL DEFECTS
Local environment approach for deep-level defects in semiconductors: Application to the vacancy in silicon
[DE88-702017] N88-29573
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591
Chemical kinetics of hydrogen and P(sub b) centers
[DE88-010528] N88-29594
Localized excitations in one-dimensional molecular crystal with structural defect
[DE88-702691] N88-29607

CRYSTAL GROWTH
High temperature electric arc furnace
[NASA-CASE-MFS-28281-1] N88-28938
New method for preparation of (Cd, Hg)Te thin films
[DE88-702727] N88-29608

CRYSTAL LATTICES
Soliton and polaron dynamics in conducting polymers
[DE88-702539] N88-29035

CRYSTAL STRUCTURE
Raman spectroscopy on simple molecular systems at very high density
[DE88-010947] N88-28987
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193788] N88-29011
Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni3Al
[DE88-702718] N88-29014
Band electronic structures and crystal packing forces
[DE88-010247] N88-29585
Preparation and testing of Nb-Zr and Nb-ZrO2 single crystals for deformation studies
[DE88-702798] N88-29613

CRYSTALLINITY
Blends of crystallizable polybutadienes
[AD-A194536] N88-29026
Preliminary analysis of recent 2.2-4.2 micrometers telescopic observations of Elysium, Mars: Implications for crystallinity and hydration state of surface materials N88-29692

CRYSTALLIZATION
Origin of SNC kaersutitic amphibole: Experimental data N88-29693

CRYSTALLOGRAPHY
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92985] N88-29617
Crystal fractionation in the SNC meteorites: Implications for surface units on Mars N88-29698

CRYSTALS
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
Research on crystal and film ferroelectric materials for optoelectronic applications
[AD-A193512] N88-29597
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599

CUBANE
Theoretical investigations of nitrocubane decomposition
[AD-A194558] N88-29047

CURING
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005

CURRENT DENSITY
Linear thyratron
[AD-A194111] N88-29094
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268

CURVATURE
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066
A technique for measuring area under a curve
[AD-A193559] N88-29463

CYCLES
Time periodic control of a multi-blade helicopter
[AD-A194435] N88-28931
Finding minimum-cost circulations by canceling negative cycles
[AD-A194027] N88-29488

CYCLOTRON RESONANCE DEVICES
Wide band gyrotron traveling wave amplifier analysis
[AD-A194269] N88-29139

CYLINDRICAL BODIES
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program)
[AD-A193678] N88-28925

CYLINDRICAL SHELLS
Nonlinear vibrations of imperfect thin walled cylindrical shells
[ETN-88-92904] N88-29205

D

DAMAGE
Procedures for identification and handling of Printed Circuit Boards (PCBs)
[AD-A191177] N88-29078
Photorefractive damage mechanism in electro-optic materials
[AD-A194560] N88-29543

DAMAGE ASSESSMENT
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-28968

DAMPING
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551

DARK MATTER
Non-linear scale invariance in a cold-dark-matter universe
[DE88-011725] N88-29644
Gravitational redshift of self-gravitating systems of dark matter in the universe
[DE88-702688] N88-29650

DATA ACQUISITION
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881
Knowledge acquisition and rapid protyping of an expert system: Dealing with real world problems N88-29394

DATA BASE MANAGEMENT SYSTEMS
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-006368] N88-29225
A relational data-knowledge base system and its potential in developing a distributed data-knowledge system N88-29353
Analyst-centered models for systems design, analysis, and development N88-29364
Avionic expert systems N88-29365
Intelligent resource management for local area networks: Approach and evolution N88-29385
The emergence of multi-user expert systems N88-29406
Central user and browse service — ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637
Catalog of open clusters and associated interstellar matter
[NASA-RP-1202] N88-29652

DATA BASES
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335
A fast parametric maximum flow algorithm, revision
[AD-A194026] N88-29345
A relational data-knowledge base system and its potential in developing a distributed data-knowledge system N88-29353
Hologram representation of design data in an expert system knowledge base N88-29354
An expert system for reliability modeling N88-29355
A knowledge-based decision support system for payload scheduling N88-29358
An approach to combining heuristic and qualitative reasoning in an expert system N88-29362
Avionic expert systems N88-29365
Knowledge elicitation for an operator assistant system in process control tasks N88-29366
Failure modes and effects analysis automation N88-29370

Knowledge based programming environments: A perspective N88-29393
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413
A survey of the current experimental database for lower hybrid current-drive and heating
[DE88-009830] N88-29552
Central user and browse service --- ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29708

DATA FLOW ANALYSIS
Faster algorithms for the shortest path problem
[AD-A194031] N88-29347
Improved time bounds for the maximum flow problem
[AD-A194034] N88-29471

DATA LINKS
Long haul underwater fiber optic link
[AD-A194487] N88-29542

DATA MANAGEMENT
Investigation of the use of High Order Languages (HOLs) for on-board software
[CRI/FR/HOL-C/1/87] N88-29349

DATA PROCESSING
Proof-of-principle high speed electronic imaging system, phase 2
[AD-A193798] N88-28937
Hierarchical organization for large, dynamic radio networks
[AD-A193942] N88-29067
Distortions in processed signals and their application in electronic design. Part 3: An automated generator of communication jamming signals
[DE88-702733] N88-29072
Waveform analysis on the IBM PC
[AD-A194249] N88-29330
ADP (Automated Data Processing) requirements definition and documentation through user-developed prototypes
[AD-A194407] N88-29332
Expert system technology as a data processing tool N88-29427
Advanced information processing system: Input/output network management software
[NASA-CR-181678] N88-29431
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29446

DATA STORAGE
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881

DATA TRANSMISSION
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193526] N88-29065
Hierarchical organization for large, dynamic radio networks
[AD-A193942] N88-29067
Distortions in processed signals and their application in electronic design. Part 1: Basic and general formulations
[DE88-702731] N88-29070
An OKQPSK modem incorporating numerically controlled carrier synthesis
[DE88-009536] N88-29304

DAYTIME
Atmospheric angular momentum and length of day
[AD-A194505] N88-29238

DECAY
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
The influence of delay effects on the decay of liquid jets
[MPIS-14/1987] N88-29130

DECAY RATES
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105

DECISION MAKING
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194625] N88-28941
Method for Veterbi decoding of large constraint length convolutional codes
[NASA-CASE-NPO-17310-1-CU] N88-28946
Motion planning for legged locomotion systems on uneven terrain N88-29170
Evaluation of atmospheric effects for operational tactical decision aid
[AD-A194205] N88-29238
A knowledge-based decision support system for payload scheduling N88-29358
An approach to combining heuristic and qualitative reasoning in an expert system N88-29362
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29446
SDI (Strategic Defense Initiative): A policy analysis
[AD-A194240] N88-29493
Distributed knowledge base systems for diagnosis and information retrieval
[AD-A193107] N88-29633

DECODING
Method for Veterbi decoding of large constraint length convolutional codes
[NASA-CASE-NPO-17310-1-CU] N88-28946

DEEP SPACE NETWORK
Mars earth-based radar: 1986 results and 1988-1990 opportunities N88-29697

DEFENSE PROGRAM
SDI (Strategic Defense Initiative): A policy analysis
[AD-A194240] N88-29493
SDI (Strategic Defense Initiative). Where do we go from here
[AD-A194544] N88-29497
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation
[AD-A193745] N88-29499

DEFLECTION
Optical measurement of unducted fan blade deflections
[NASA-TM-100966] N88-29142

DEFORMATION
The high temperature creep deformation of Si3N4-6Y2O3-2Al2O3
[NASA-CR-183204] N88-28981
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
Preparation and testing of Nb-Zr and Nb-ZrO2 single crystals for deformation studies
[DE88-702796] N88-29613

DEGRADATION
Long-term behavior of energy production systems with the example of HELIOS and SYMPHONIE
[ETN-88-92968] N88-29223

DEGREES OF FREEDOM
Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: Numerical and analytical results
[DE88-702747] N88-29473

DELAY
The influence of delay effects on the decay of liquid jets
[MPIS-14/1987] N88-29130

DELTA WINGS
Delta wing configurations N88-28860
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895

DENSITY MEASUREMENT
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240

DEPLOYMENT
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177

DEPOSITION
Atmospheric deposition of nitrate to the ocean surface N88-29227
New method for preparation of (Cd, Hg)Te thin films
[DE88-702727] N88-29608

DEPOSITS
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684
Early cratering rates and the nature of the Martian cratered uplands N88-29694
Ridged and gullied terrains in the Martian uplands N88-29700

DEPTH
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276

DESIGN ANALYSIS
A contribution to the quantitative analysis of the influence of design parameters on the optimal design of passenger aircraft
[ETN-88-92979] N88-28912
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 1
[NASA-CR-178973] N88-28964
LLE (Laboratory for Laser Energetics) review
[DE88-008065] N88-29158
Leaf spring
[GB-PATENT-2-192-689-A] N88-29179
Digital filter design techniques
[AD-A194484] N88-29486

DETECTION
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
Infrared detection using Rydberg atoms
[AD-A194308] N88-28990
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079
Airborne radar technology for windshear detection
[NASA-CR-183203] N88-29257
An investigation of acoustic cavitation produced by pulsed ultrasound
[AD-A193523] N88-29516
Neutrino detection primer
[AD-A193805] N88-29529

DETECTORS
Miniature respiratory sensor
[AD-A193430] N88-29300

DETONATION
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29046

DIAGNOSIS
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis)
[AD-A193580] N88-29117
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
Distributed knowledge base systems for diagnosis and information retrieval
[AD-A193107] N88-29633

DIAGRAMS
Characterization of lubricants in terms of transition diagram data
[AD-A194264] N88-29025

DIAMAGNETISM
The thermal conductivity of dirty type 2 superconductors
[B8681488] N88-29615

DIAMETERS
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972

DIAMONDS
The diamond as a new electronic material
[NASA-TT-20354] N88-29098
Diamond film by hot filament CVD method
[NASA-TT-20335] N88-29618

DIATOMIC MOLECULES
Nuclear magnetic ordering and paramagnetic relaxation of diatomic molecules in Ca (OH)2
[B8681489] N88-29532

DIELECTRIC PROPERTIES
Effects on the resonant frequencies caused by loading a spherical cavity with a dielectric sphere
[AD-A193864] N88-29511

DIELECTRICS
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
Effects on the resonant frequencies caused by loading a spherical cavity with a dielectric sphere
[AD-A193864] N88-29511
Research on crystal and film ferroelectric materials for optoelectronic applications
[AD-A193512] N88-29597

DIFFERENTIAL EQUATIONS
Convex duality approach to the optimal control or diffusions
[AD-A194535] N88-29442
On the distribution equations
[DE88-702217] N88-29454

Minimizing escape probabilities: A large deviations approach
[AD-A194534] N88-29496
Mathematical theory and calculations of magnetic hysteresis curves
[DE88-011055] N88-29510
Resonance excitation of linear and non-linear spiral density waves in a gaseous disk N88-29643

DIFFERENTIAL GEOMETRY
Critical values of functionals on Banach surfaces
[DE88-702735] N88-29472

DIFFRACTION
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972
Qualitative characteristics of open waveguide resonator spectra
[DE88-702387] N88-29056

DIFFRACTION RADIATION
Diffraction transition radiation from periodic electron bunches
[AD-A193593] N88-29528

DIFFUSION
Evaluation of a diffusion/trapping model for hydrogen ingress in high-strength alloys
[AD-A194301] N88-29008
Transport of organic vapors in multiphase polymer system
[AD-A194097] N88-29033
Convex duality approach to the optimal control or diffusions
[AD-A194535] N88-29442
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29457
Minimizing escape probabilities: A large deviations approach
[AD-A194534] N88-29496

DIFFUSION WELDING
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009

DIGITAL FILTERS
Computer aided filter design
[AD-A193959] N88-29093
Digital filter design techniques
[AD-A194484] N88-29486

DIGITAL SIMULATION
Crash simulation calculations and component idealization for an airframe. Computer code KRASH 79
[ETN-88-92971] N88-28899
Coupling expert systems and simulation N88-29360
Modeling of a cometary dust coma
[ETN-88-92960] N88-29651

DIGITAL SYSTEMS
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
Distortions in processed signals and their application in electronic design. Part 1: Basic and general formulations
[DE88-702731] N88-29070
Digital phase-lock loop having an estimator and predictor of error
[NASA-CASE-NPO-17196-1-CU] N88-29076
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194246] N88-29237
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487

DIGITAL TECHNIQUES
Avionics system design for high energy fields: A guide for the designer and airworthiness specialist
[NASA-CR-181590] N88-28919
Nanosequencer digital logic controller
[NASA-CASE-NPO-16116-2] N88-29310

DILUTION
DARPA-URI consortium meetings on submicron heterostructures of diluted magnetic semiconductors
[AD-A193499] N88-29081

DIMENSIONAL MEASUREMENT
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972

DIMENSIONAL STABILITY
Contribution to the study of materials behavior in space environment
[SNIAS-881-430-104] N88-28977

DIMENSIONLESS NUMBERS
Can we calculate the fundamental dimensionless constants of physics
[DE88-702641] N88-29625

DIMENSIONS
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: Numerical and analytical results
[DE88-702747] N88-29473
Cosmology in an N-dimensional vector space
[DE88-702550] N88-29507

DIODES
The 1985-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226

DIOXIDES
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

DIPOLE MOMENTS
Cooperative effects and intrinsic optical bistability in collections of atoms
[AD-A193993] N88-29530
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624

DIRECT CURRENT
Arcjet power supply and start circuit
[NASA-CASE-LEW-14374-1] N88-28939

DIRECT POWER GENERATORS
Long-term behavior of energy production systems with the example of HELIOS and SYMPHONIE
[ETN-88-92988] N88-29223

DIRECTIONAL STABILITY
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-28891

DISCRETE FUNCTIONS
Stability of semidiscrete approximations for hyperbolic initial-boundary-value problems: Stationary modes
[NASA-TM-100994] N88-29455
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29457

DISCRIMINATION
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487

DISKS (SHAPES)
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program)
[AD-A193678] N88-28925

DISPENSERS
Method of dispensing reagent chemicals in space
[NASA-CASE-LAR-13607-1-CU] N88-29048

DISPERSIONS
Theoretical and experimental investigations on the structure of stationary shock waves in gas particle dispersions
[ETN-88-92983] N88-29122

DISPLACEMENT MEASUREMENT
J-integral measurement using moire interferometry
[AD-A193751] N88-29202
A technique for measuring area under a curve
[AD-A193559] N88-29463

DISPLAY DEVICES
Future visual environment and concerns N88-29299

DISSOCIATION
Measurements of XeF (Xenon Fluoride) ground state dissociation and vibrational equilibration
[AD-A194611] N88-29527

DISSOLVING
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027

DISTORTION
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28896
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066
Distortions in processed signals and their application in electronic design. Part 1: Basic and general formulations
[DE88-702731] N88-29070
Distortions in processed signals and their application in electronic design. Part 2: A new variable signal generator
[DE88-702732] N88-29071
Distortion estimates for negative Schwarzian maps
[AD-A193172] N88-29209

DISTRIBUTED PROCESSING
Intelligent test integration system N88-29371
Distributed cooperating processes in a mobile robot control system N88-29386
AI and simulation: What can they learn from each other N88-29391
An expert system for a distributed real-time trainer N88-29411
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29446
Dynamically reconfigurable distributed database systems
[AD-A194716] N88-29636

DISTRIBUTION (PROPERTY)
Measurements of vacuum arc ion charge state distributions
[DE88-006249] N88-29558

DISTRIBUTION FUNCTIONS
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise
[AD-A193865] N88-29492
Sequential approach to Colombeau's theory of generalized functions
[DE88-701869] N88-29503
Moment invariants for particle beams
[DE88-011052] N88-29537

DOCUMENTATION
Technical communication in the computer industry: An information-development process to track, measure and ensure quality N88-29635

DOPED CRYSTALS
Blue-green laser diode research program
[AD-A191980] N88-29153
Solid-state laser research report: Energy transfer in non-uniform codoped crystals
[AD-A194358] N88-29161

DOPPLER RADAR
Airborne radar technology for windshear detection
[NASA-CR-183203] N88-29257

DOSAGE
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266

DOSIMETERS
A study of the National Physics Laboratory microdosimetry research programme in collaboration with the University of Leeds (United Kingdom)
[NPL-RS(EXT)-93] N88-29148

DOWNLINKING
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077

DROPS (LIQUIDS)
Combustion studies of acoustically suspended liquid droplets
[AD-A193892] N88-28998
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration
[AD-A193825] N88-29164

DRUGS
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267

DRY FRICTION
Dry adhesive friction of elastomers: A study of the fundamental mechanical aspects
[ETN-88-92903] N88-29036

DUCTS
Steady and unsteady internal flow computations via the solution of the compressible Navier Stokes equations for low Mach numbers N88-29100
Optical measurement of unducted fan blade deflections
[NASA-TM-100966] N88-29142

DUST
How dirty is Mars' North Polar cap, and why isn't it black N88-29677
The surface composition of Mars from earthbased observations N88-29696

DWARF STARS
Molecular hydrogen in galaxies N88-29645

DYES
Evidence for laser emission from the TICT exciplex of coumarin dyes
[DE88-702544] N88-29167

DYNAMIC CHARACTERISTICS
Spallation and dynamic fracture as an effect of laser induced shock-waves
[AD-A193513] N88-28971

A multiple-scales partial solution of the pulse-forced Rayleigh-Plesset equation of cavitation bubble dynamics [AD-A193733] N88-29118
Interactions between synoptic and planetary scales of motion [AD-A192328] N88-29246
Transformations of short-term visual memory [AD-A193873] N88-29290
The acoustic field scattered from some approximate pressure release materials [AD-A194768] N88-29515

DYNAMIC CONTROL
Hierarchical organization for large, dynamic radio networks [AD-A193942] N88-29067
Anti-aliasing filters for dynamics and control experiments [AD-A193758] N88-29203
Topics in adaptive control and inference [AD-A194718] N88-29443

DYNAMIC LOADS
Static and dynamic metal-metal friction at plastic stress levels [DE88-011261] N88-29176
Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V [DE88-006458] N88-29197
An investigation of acoustic cavitation produced by pulsed ultrasound [AD-A193523] N88-29516

DYNAMIC MODELS
Performance of GPS-aided INS during high-dynamic maneuvers [AD-A194624] N88-29903
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis) [AD-A193580] N88-29117
Dynamics of interacting galaxies N88-29647

DYNAMIC RESPONSE
Structural dynamics of maneuvering aircraft [AD-A192376] N88-28908
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191
Dynamic response of a 330-kW horizontal axis wind turbine generator [DE88-001136] N88-29212
Dynamic analysis of computer and communications sytems: Semi-Markov approach N88-29305

DYNAMIC STRUCTURAL ANALYSIS
Structural dynamics of maneuvering aircraft [AD-A192376] N88-28908
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics [NASA-CR-182516] N88-29328
ASKA-acoustics: Theory and applications --- vibro acoustics [FFA-TN-1988-13] N88-29519

DYNAMICAL SYSTEMS
Analytical investigation of the dynamics of tethered constellations in earth orbit [NASA-CR-179371] N88-28950
Method of forming dynamic membrane on stainless steel support [NASA-CASE-MSC-18172-3] N88-29052
Coupling expert systems and simulation N88-29360
Unfoldings of quasi-periodic tori [B6811118] N88-29513
Can we calculate the fundamental dimensionless constants of physics [DE88-702641] N88-29625

E

EARTH ATMOSPHERE
Atmospheric angular momentum and length of day [AD-A194505] N88-29238
Basic causes of amplitude modulation in climatic/weather parameters [DE88-702743] N88-29254
Hadrons produced in atmospheric interactions [DE88-702492] N88-29712

EARTH CRUST
Seismic reflection experiments imaging the physical nature of crustal structures in southern California N88-29235

EARTH IONOSPHERE
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 1: Atomic ions (H(+), He(+), N(+), O(+)) [DFVLR-FB-88-11-PT-1] N88-29241
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 2: Molecular ions (N2(+), NO(+), O2(+)) and electron density [DFVLR-FB-88-12-PT-2] N88-29242

ECHOCARDIOGRAPHY
Variation of carotid flow under load, studied by the Doppler echo method --- acceleration tolerance [REPT-1149] N88-29282

ECONOMIC ANALYSIS
Absorption heat pumps [DE88-752820] N88-29218

ECONOMIC FACTORS
Real-time space system control with expert systems N88-29419

EDDY CURRENTS
The calculation of time dependent eddy currents in tokamaks [REPT-206] N88-29568

EDGES
Analysis of edge detection techniques for radiographic image measurement [AD-A193650] N88-28961
A linear-time algorithm for finding a minimum spanning pseudoforest [AD-A194029] N88-29346
Improved time bounds for the maximum flow problem [AD-A194034] N88-29471

EDUCATION
Effects of psychophysical lifting training on maximal repetitive lifting capacity [AD-A192605] N88-29271
Future air-to-air training for the RF-4 [AD-A194363] N88-29284
Proposed improvements to the USAF flight screening program [AD-A194506] N88-29285
Commentary on Harold Hotelling's articles on the teaching of statistics [AD-A194215] N88-29484

EFFICIENCY
Recent advances in high-power microwave amplifiers [DE88-007820] N88-29083
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1 [AD-A194166] N88-29110

EFFUSIVES
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
Volcano evolution on Mars N88-29686

EIGENVALUES
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method [AD-A193479] N88-29104
Solving the symmetric tridiagonal eigenvalue problem on the hypercube [AD-A193905] N88-29344

EINSTEIN EQUATIONS
Towards a finite quantum gravity [DE88-701497] N88-29619

EJECTA
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701

ELASTIC CYLINDERS
The acoustic field scattered from some approximate pressure release materials [AD-A194768] N88-29515

ELASTIC PLATES
Elastic wave dispersion in laminated composite plate [AD-A192289] N88-28967

ELASTIC PROPERTIES
Elastic behavior of a rubber layer bonded between two rigid spheres [AD-A193696] N88-29030
Metal halide optical glasses [AD-A193794] N88-29032

ELASTIC SCATTERING
Dispersion effects in elastic electron scattering from C12 [B8805297] N88-29536

ELASTIC SHELLS
The acoustic field scattered from some approximate pressure release materials [AD-A194768] N88-29515

ELASTOMERS
Dry adhesive friction of elastomers: A study of the fundamental mechanical aspects [ETN-88-92903] N88-29036

ELASTOPLASTICITY
Results on the influence of crack tip plasticity during dynamic crack growth [AD-A193460] N88-29194

ELECTRIC ARCS
Measurements of vacuum arc ion charge state distributions [DE88-008249] N88-29558

ELECTRIC DISCHARGES
Surface properties in electric discharge machining [NASA-TT-20243] N88-29182

ELECTRIC FIELDS
Kinetic theory for electrostatic waves due to transverse velocity shears [AD-A193404] N88-29557

ELECTRIC MOMENTS
Neutrino electrodynamics and possible effects for solar neutrinos [DE88-701647] N88-29705

ELECTRIC NETWORKS
On broadband matching of multiport electrical networks with applications [AD-A194224] N88-29086

ELECTRICAL INSULATION
System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice [DE88-702686] N88-29606

ELECTRICAL MEASUREMENT
Results of the use of an automated electrical measuring instrument calibration system [SNIAS-881-430-107] N88-29148

ELECTRICAL RESISTIVITY
High temperature electric arc furnace [NASA-CASE-MFS-28281-1] N88-28938
Polymeric electrolytes [AD-A193766] N88-29031
Soliton and polaron dynamics in conducting polymers [DE88-702539] N88-29035
The 1983 direct strike lightning data, part 1 [NASA-TM-86426-PT-1] N88-29259
The 1983 direct strike lightning data, part 2 [NASA-TM-86426-PT-2] N88-29260
The 1983 direct strike lightning data, part 3 [NASA-TM-86426-PT-3] N88-29261
Thermostimulated conductivity in amorphous semiconductors with non-exponential density of localized states [DE88-702737] N88-29612
Electrical conductivity of GaAs layers implanted on semi-insulator nondoped substrates [CERT-422000/RF] N88-29614
Temperature dependence of conductivity and of Hall coefficients for noble metal films [ETN-88-92981] N88-29616

ELECTRO-OPTICAL PHOTOGRAPHY
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system [AD-A193473] N88-29137

ELECTRO-OPTICS
MIDIR (Mid-Infrared) laser, phase 1 [AD-A193935] N88-29166
Photorefractive damage mechanism in electro-optic materials [AD-A194580] N88-29543
Quasi-liquid crystalline materials with special electro-optic properties [AD-A194579] N88-29544
Center for opto-electronic systems research instrumentation grant [AD-A193711] N88-29545
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575
Research on crystal and film ferroelectric materials for optoelectronic applications [AD-A193512] N88-29597

ELECTROCHEMICAL CORROSION
Laser and electrochemical studies of metallizations in electronic devices [AD-A193786] N88-29090

ELECTROCHEMISTRY
Phenomena of the ionic transport in the stress corrosion of metals [DE88-702502] N88-29013
Polymeric electrolytes [AD-A193766] N88-29031
Electrochemical and optical studies of model photosynthetic systems [DE88-009291] N88-29264
Potential induced structural transformations of the Au(100) and Au(111) surfaces [DE88-005446] N88-29571

ELECTRODES
Liquid metal thermal-electric converter electrode development [DE88-009252] N88-29221

ELECTRODYNAMICS
Snapshots of high-latitude electrodynamics using Viking and DMSP/F7 observations [TRITA-EPP-88-01] N88-29244
Neutrino electrodynamics and possible effects for solar neutrinos [DE88-701647] N88-29705

ELECTROENCEPHALOGRAPHY
Methods and instrumentation for biomagnetism
[AD-A193811] N88-29278
ELECTROLYTES
Potential induced structural transformations of the Au(100) and Au(111) surfaces
[DE88-005446] N88-29571
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
ELECTROMAGNETIC FIELDS
Open boeonic string in background electromagnetic field
[DE88-702140] N88-29053
Development of a multiport-hybrid-mode exciter for use in antennas for polarimetric field measurements
[REPT-12-87] N88-29075
The 1983 direct strike lightning data, part 1
[NASA-TM-86426-PT-1] N88-29259
The 1983 direct strike lightning data, part 2
[NASA-TM-86426-PT-2] N88-29260
The 1983 direct strike lightning data, part 3
[NASA-TM-86426-PT-3] N88-29261
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624
Neutrino electrodynamics and possible effects for solar neutrinos
[DE88-701647] N88-29705
ELECTROMAGNETIC INTERACTIONS
Space-charge-wave solid state microwave amplifier
[AD-A193792] N88-29091
ELECTROMAGNETIC MEASUREMENT
Wind measurements by electromagnetic probes
[NASA-TM-4066] N88-29256
The 1983 direct strike lightning data, part 1
[NASA-TM-86426-PT-1] N88-29259
The 1983 direct strike lightning data, part 2
[NASA-TM-86426-PT-2] N88-29260
The 1983 direct strike lightning data, part 3
[NASA-TM-86426-PT-3] N88-29261
ELECTROMAGNETIC NOISE
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
ELECTROMAGNETIC PULSES
Waveform analysis on the IBM PC
[AD-A194249] N88-29330
ELECTROMAGNETIC WAVE TRANSMISSION
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation
[AD-A193958] N88-29068
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268
ELECTRON BEAM WELDING
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
ELECTRON BEAMS
The NBS/NRL (National Bureau of Standards/Naval Research Laboratory) free electron laser facility
[AD-A194214] N88-29159
Diffraction transition radiation from periodic electron bunches
[AD-A193593] N88-29528
Plasmoid propagation
[AD-A192378] N88-29555
ELECTRON BUNCHING
Diffraction transition radiation from periodic electron bunches
[AD-A193593] N88-29528
ELECTRON CYCLOTRON HEATING
A survey of the current experimental database for lower hybrid current-drive and heating
[DE88-009630] N88-29552
Initial operation and edge plasma studies in ATF (Advanced Toroidal Facility)
[DE88-011400] N88-29562
ELECTRON DENSITY (CONCENTRATION)
Linear thyratron
[AD-A194111] N88-29094
ELECTRON DIFFRACTION
Diffraction transition radiation from periodic electron bunches
[AD-A193593] N88-29528
ELECTRON EMISSION
Hot electron emission in semiconductors
[AD-A194101] N88-29601
ELECTRON IMPACT
Electron impact ionization cross-section of some organic compounds
[DE88-702044] N88-29525
ELECTRON IRRADIATION
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92965] N88-29617
ELECTRON MICROSCOPY
Electron microscopy of ceramic superconductors
[DE88-006446] N88-29580
ELECTRON PARAMAGNETIC RESONANCE
Photorefractive damage mechanism in electro-optic materials
[AD-A194560] N88-29543
Chemical kinetics of hydrogen and P(sub b) centers
[DE88-010526] N88-29594
ELECTRON PUMPING
Blue-green laser diode research program
[AD-A191960] N88-29153
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165
ELECTRON SCATTERING
Effect of a laser field in the electron inelastic scattering into plasma fields
[DE88-702295] N88-29157
On selection rules and inelastic electron scattering at intermediate energies
[DE88-701833] N88-29526
Dispersion effects in elastic electron scattering from C12
[B8805297] N88-29536
ELECTRON STATES
Charge storage and switching phenomena in metal complexes
[AD-A193778] N88-28996
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193881] N88-28997
Theoretical investigation of image states of the hydrogen covered Cu (100)
[DE88-702662] N88-29604
ELECTRON TRANSFER
Electrochemical and optical studies of model photosynthetic systems
[DE88-009291] N88-29264
ELECTRON TUNNELING
Tunnelling currents in reverse biased CMT photodiodes
[RSRE-MEMO-4137] N88-29097
ELECTRONIC COUNTERMEASURES
Distortions in processed signals and their application in electronic design. Part 3: An automated generator of communication jamming signals
[DE88-702733] N88-29072
ELECTRONIC EQUIPMENT
Avionics system design for high energy fields: A guide for the designer and airworthiness specialist
[NASA-CR-181590] N88-28919
Laser and electrochemical studies of metallizations in electronic devices
[AD-A193786] N88-29090
Center for opto-electronic systems research instrumentation grant
[AD-A193711] N88-29545
ELECTRONIC SPECTRA
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079
ELECTRONS
Large area nuclear particle detectors using ET materials
[NASA-CR-180777] N88-29136
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706
ELECTROSTATIC CHARGE
Procedures for identification and handling of Printed Circuit Boards (PCBs)
[AD-A191177] N88-29078
ELECTROSTATIC WAVES
Kinetic theory for electrostatic waves due to transverse velocity shears
[AD-A193404] N88-29557
ELECTROSTATICS
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240
ELLIPSOIDS
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence
[FFA-TN-1988-02] N88-29126
ELLIPTIC DIFFERENTIAL EQUATIONS
Composite grid generation for aircraft configurations with the EAGLE code N88-29321
Nonlinear elliptic problems with critical exponent in shrinking annuli
[W-87-02] N88-29477
Elliptic equations with nearly critical growth
[W-87-18] N88-29478
ELONGATION
Phenomena of the ionic transport in the stress corrosion of metals
[DE88-702502] N88-29013
EMBEDDED COMPUTER SYSTEMS
Design consideration in constructing high performance embedded Knowledge-Based Systems (KBS)
N88-29315
EMBEDDING
Archetyping: A software generation and management methodology N88-29382
EMBRITTLEMENT
Method and apparatus for non-destructive testing of temper embrittlement in steels
[NASA-CASE-LAR-13817-1] N88-29012
EMISSION
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3
[AD-A194670] N88-29239
EMISSIVITY
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
EMPTYING
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29251
ENERGETIC PARTICLES
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947
ENERGY
Difficulties with interpretation of underground muons from Cygnus X-3
[DE88-701645] N88-29710
ENERGY CONSERVATION
Reduction in mill air compressor power requirements through installation of a variable frequency speed control
[DE88-008493] N88-29171
ENERGY CONVERSION
Hydrogen concentration cells as converters of heat into electricity
[DE88-009662] N88-29216
ENERGY DISSIPATION
Mathematical theory and calculations of magnetic hysteresis curves
[DE88-011055] N88-29510
ENERGY GAPS (SOLID STATE)
Theoretical investigation of image states of the hydrogen covered Cu (100)
[DE88-702662] N88-29604
ENERGY LEVELS
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3
[AD-A194670] N88-29239
Electronic states in tunneling semiconductor superlattices
[DE88-011571] N88-29587
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599
Relativistic theory of the Lamb shift based on self energy
[DE88-702658] N88-29626
ENERGY POLICY
Solar dynamic power systems
[ETN-88-92969] N88-29224
ENERGY SPECTRA
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947
ENERGY STORAGE
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28960
Charge storage and switching phenomena in metal complexes
[AD-A193778] N88-28996
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
ENERGY TRANSFER
Solid-state laser research report: Energy transfer in non-uniform codoped crystals
[AD-A194358] N88-29161

Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow
[AD-A194479] N88-29162
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow
[AD-A194493] N88-29163

ENGINE INLETS
Experimental and analytical evaluation of the effects of simulated engine inlets on the blade vibratory stresses of the SR-3 model prop-fan
[NASA-CR-174959] N88-28927

ENTROPY
Investigations on the entropy of cloudy air
[ESA-TT-1060] N88-29245
Monotone recurrence relations, their Birkhoff orbits and topological entropy
[AD-A193481] N88-29504

ENVIRONMENT EFFECTS
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-008368] N88-29225

ENVIRONMENT MODELS
Weathering of sulfides on Mars N88-29662

ENVIRONMENTAL CONTROL
ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29380

ENVIRONMENTS
Nutrient requirements for high stress environments
[AD-A194595] N88-29301

ENZYMES
The design of methane activation catalysts
[DE88-002265] N88-29043

EPITAXY
Blue-green laser diode research program
[AD-A191980] N88-29153
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595

EPOXY RESINS
Optical emission behavior and radiation resistance of epoxy resins
[DE88-752629] N88-29023

EQUATIONS OF MOTION
Open bosonic string in background electromagnetic field
[DE88-702140] N88-29053
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515

EQUIPMENT SPECIFICATIONS
Elemental composition of the Martian surface N88-29665
Gamma-ray/neutron spectroscopy from the Mars observer N88-29671
Very high energy cosmic gamma rays from radio and X-ray pulsars N88-29711

EQUIVALENCE
On matrix pencil equivalents of a general polynomial matrix
[MATH-REPT-207] N88-29479

EROSION
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
Spectral characteristics and the extent of paleosols of the Palouse formation
[NASA-CR-180947] N88-29210
Distribution and timing of thick transient air-fall deposits in Electris: Implications for the nature of the upland plains N88-29674

ERROR ANALYSIS
Fine resolution errors in secondary surveillance radar altitude reporting
[RSRE-87019] N88-28906
Digital phase-lock loop having an estimator and predictor of error
[NASA-CASE-NPO-17196-1-CU] N88-29076

ERROR DETECTION CODES
Knowledge-based fault diagnosis on future space vehicles N88-29374

ERRORS
On Wiener-Masani's algorithm for finding the generating function of multivariate stochastic processes
[NASA-CR-182905] N88-29481

ERS-1 (ESA SATELLITE)
Central user and browse service --- ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637

ESA SATELLITES
Study of a safe attitude for the Infrared Space Observatory (ISO) during perigee pass
[SNIAS-881-440-113] N88-28954

ESTERS
Polyazidoesters as energetic polymers and copolymer components with fluoro derivatives
[AD-A194236] N88-29039

ESTIMATES
Estimation forces acting on an underwater vehicle with G.P.S. (Global Positioning System) and Kalman filtering
[AD-A194339] N88-28901
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670

ESTIMATING
Digital phase-lock loop having an estimator and predictor of error
[NASA-CASE-NPO-17196-1-CU] N88-29076
Estimation of transient heat transfer coefficients in multidimensional problems by using inverse heat transfer methods N88-29108
A minitab macro for the Kaplan-Meier product limit estimator and the Tarone-Ware class of tests
[AD-A194296] N88-29331
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29446
Two biased estimation techniques in linear regression: Application to aircraft
[NASA-TM-100649] N88-29489

ETHYL COMPOUNDS
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027

EULER EQUATIONS OF MOTION
The influence of numerical boundary conditions on transonic flow
[DFVLR-FB-88-06] N88-28890
Accurate solutions, parameter studies and comparisons for the Euler and potential flow equations
[NASA-TM-100664] N88-28892
Generation of multiple block grids for arbitrary 3D geometries N88-29317
Mesh generation for industrial application of Euler and Navier Stokes solvers N88-29323

EULER-CAUCHY EQUATIONS
On the distribution equations
[DE88-702217] N88-29454

EURECA (ESA)
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956

EUROPEAN AIRBUS
Variable wing camber control systems for the future Airbus program
[MBB-UT-104/88] N88-28932

EUROPEAN SPACE AGENCY
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
Focus 86: A summary of the 1986 annual report of the activities of the European Space Agency
[ESA-BR-34] N88-29713

EUROPEAN SPACE PROGRAMS
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
Focus 86: A summary of the 1986 annual report of the activities of the European Space Agency
[ESA-BR-34] N88-29713

EVACUATING (TRANSPORTATION)
Smoke hoods: Net safety benefit analysis --- aircraft accidents
[CAA-PAPER-87017] N88-28898

EVALUATION
Reliability assessment of Surface Mount Technology (SMT)
[AD-A193759] N88-29089
Present state of knowledge of the upper atmosphere 1988: An assessment report
[NASA-RP-1208] N88-29233
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation
[AD-A193745] N88-29499

EVEN-EVEN NUCLEI
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570

EVOKED RESPONSE (PSYCHOPHYSIOLOGY)
Human auditory and visual continuous evoked potentials N88-29269

EVOLUTION (DEVELOPMENT)
Intercrater plains deposits and the origin of Martian valleys N88-29661
Volcano evolution on Mars N88-29686

EXCIMER LASERS
Laser and electrochemical studies of metallizations in electronic devices
[AD-A193786] N88-29090

EXCITATION
Evidence for laser emission from the TICT exciplex of coumarin dyes
[DE88-702544] N88-29167
Investigation of non-classical effects in two-photon interference processes N88-29541
Localized excitations in one-dimensional molecular crystal with structural defect
[DE88-702691] N88-29607
Localized excitations in one-dimensional molecular crystal with structural defect
[DE88-702691] N88-29607

EXERCISE PHYSIOLOGY
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29281

EXPANSION
Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants
[DE88-701621] N88-29174
Cosmology in an N-dimensional vector space
[DE86-702550] N88-29507

EXPERT SYSTEMS
Cooperating knowledge-based systems
[NASA-CR-183109] N88-29327
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-86-62] N88-29352
A relational data-knowledge base system and its potential in developing a distributed data-knowledge system N88-29353
Hologram representation of design data in an expert system knowledge base N88-29354
An expert system for reliability modeling N88-29355
A software engineering approach to expert system design and verification N88-29356
Issues on the use of meta-knowledge in expert systems N88-29357
A knowledge-based decision support system for payload scheduling N88-29358
Coupling expert systems and simulation N88-29360
Optimization of low gravity materials processing experiments using expert systems N88-29361
An approach to combining heuristic and qualitative reasoning in an expert system N88-29362
Expertise and reasoning with possibility: An explanation of modal logic and expert systems N88-29363
Analyst-centered models for systems design, analysis, and development N88-29364
Avionic expert systems N88-29365
Knowledge elicitation for an operator assistant system in process control tasks N88-29366
Machine vision for real time orbital operations N88-29367
Automatic object recognition N88-29368
Two dimensional convolute integers for machine vision and image recognition N88-29369
On recognizing ignorance N88-29372
Expert systems for MSFC power systems N88-29375
A generic expert system for materials processing in space N88-29376
ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29380
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29381
A scheduling and resource management system for space applications N88-29383
An expert systems application to space base data processing N88-29384
Generic supervisor: A knowledge-based tool for control of space station on-board systems N88-29389
Knowledge based programming environments: A perspective N88-29393
Knowledge acquisition and rapid protyping of an expert system: Dealing with real world problems N88-29394
Automated generation of spacecraft activity plans N88-29396
Intelligent interfaces for expert systems N88-29397
Requirements for a tool to aid in the development of expert systems for space station applications N88-29398
Benchmarking expert system tools N88-29399
Two implementations of the Expert System for the Flight Analysis System (ESFAS) project N88-29400
Life-span knowledge engineering for space operations N88-29401
NOA: A Network Operator Assistant for scheduling Tracking and Data Relay Satellite System (TDRSS) N88-29403
Experiment scheduling for Spacelab missions N88-29404

The emergence of multi-user expert systems N88-29406
An expert system for a distributed real-time trainer N88-29411
Utilization of artificial intelligence techniques for the Space Station power system N88-29412
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413
Design consideration in constructing high performance embedded Knowledge-Based Systems (KBS) N88-29415
Validation of expert systems N88-29416
Mathematical algorithms for approximate reasoning N88-29418
Real-time space system control with expert systems N88-29419
A flexible search strategy for production systems N88-29420
Semantic based man-machine interface for real-time communication N88-29421
Automated software development workstation N88-29423
An expert system for natural language processing N88-29426
Expert system technology as a data processing tool N88-29427
Next-generation space manipulator N88-29428
Parallel real-time expert systems [AD-A193673] N88-29434
Contribution of expert systems to avionics advance. Application on AS30 laser weapon system [SNIAS-881-320-103] N88-29449
Active explanation reduction: An approach to the multiple explanations problem [AD-A194127] N88-29501

EXPLOSIONS
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces [DE88-004686] N88-29006

EXPONENTS
Nonlinear elliptic problems with critical exponent in shrinking annuli [W-87-02] N88-29477

EXTINCTION
Evaluation of atmospheric effects for operational tactical decision aid [AD-A194205] N88-29236

EXTREMELY HIGH FREQUENCIES
The 44/20 GHz ground terminal [AD-A194002] N88-29069

EYE (ANATOMY)
Future visual environment and concerns N88-29299

F

F REGION
Ionospheric convection and structure using ground-based digital ionosondes [AD-A194246] N88-29237

F-16 AIRCRAFT
Three-dimensional elliptic grid generation for an F-16 N88-29315

F-106 AIRCRAFT
Investigations into the triggered lightning response of the F106B thunderstorm research aircraft [NASA-CR-3902] N88-29258

FABRICATION
Method for Veterbi decoding of large constraint length convolutional codes [NASA-CASE-NPO-17310-1-CU] N88-28946
A fundamental study of P/M processed elevated temperature aluminum alloys [AD-A192958] N88-29005
Advanced processing and properties of high performance alloys [AD-A193767] N88-29010
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering [DE88-009977] N88-29583

FACTOR ANALYSIS
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics [NASA-CR-182516] N88-29328

FAILURE
Approximate evaluation of semi-Markov chain reliability models [AD-A194669] N88-29185
Plastic flow and failure modeling under high strain rate loading [AD-A194223] N88-29199
Critical conditions for failure in materials subjected to high rates of loading [AD-A194697] N88-29201
Systolic array fault tolerance performance analysis [AD-A193521] N88-29306
Exact lower confidence limits for the reliability of k of n systems for zero failures and nonconservativeness of the maximus method [AD-A194299] N88-29485

FAILURE ANALYSIS
An expert system for reliability modeling N88-29355
Failure modes and effects analysis automation N88-29370
ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29380
Utilization of artificial intelligence techniques for the Space Station power system N88-29412
A nonlinear filtering process diagnostic system for the Space Station N88-29417

FAILURE MODES
Thin film-residual stress assessment [AD-A193205] N88-29018
A study of the floating roller peel test for adhesives [AD-A194114] N88-29034
Visual related accidents/incidents N88-29293
Failure modes and effects analysis automation N88-29370

FAN BLADES
Optical measurement of unducted fan blade deflections [NASA-TM-100966] N88-29142

FAST FOURIER TRANSFORMATIONS
Waveform analysis on the IBM PC [AD-A194249] N88-29330

FATIGUE (MATERIALS)
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193

FATIGUE LIFE
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program) [AD-A193678] N88-28925

FATIGUE TESTS
AGARD engine disc cooperative test programme [AGARD-R-766] N88-28926

FAULT TOLERANCE
Approximate evaluation of semi-Markov chain reliability models [AD-A194669] N88-29185
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems [AD-A193526] N88-29186
Systolic array fault tolerance performance analysis [AD-A193521] N88-29306
Knowledge-based fault diagnosis on future space vehicles N88-29374
ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29380
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29381
Knowledge acquisition and rapid protyping of an expert system: Dealing with real world problems N88-29394
Reasoning about fault diagnosis for the space station common module thermal control system N88-29395
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413
Semantic based man-machine interface for real-time communication N88-29421

FEASIBILITY ANALYSIS
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 1 [NASA-CR-178973] N88-28964
Space-charge-wave solid state microwave amplifier [AD-A193792] N88-29091
Large area nuclear particle detectors using ET materials [NASA-CR-180777] N88-29136
Advanced development waste processing unit for combat vehicles, phase 2 [AD-A193793] N88-29302
Feasibility study of a microprocessor controlled actuator test mechanism [AD-A194654] N88-29337
Lattice-matched HgZnTe epitaxy development [AD-A193677] N88-29600
New developments in capital cost estimating [DE88-005392] N88-29638

FEDERAL BUDGETS
Competition: Issued on establishing and using Federally funded research and development centers [PB88-178884] N88-29632

FEEDBACK CONTROL
Time periodic control of a multi-blade helicopter [AD-A194435] N88-28931
Robust control of multivariable and large scale systems [AD-A194250] N88-29441

FERMIONS
Gravitational redshift of self-gravitating systems of dark matter in the universe [DE88-702688] N88-29650

FERROELECTRICITY
Research on crystal and film ferroelectric materials for optoelectronic applications [AD-A193512] N88-29597

FIBER COMPOSITES
Elastic wave dispersion in laminated composite plate [AD-A192289] N88-28967
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites [UTIAS-324] N88-28970
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation [AD-A193524] N88-28972
An investigation of some basic properties of hybrid composite materials [AD-A194136] N88-28975
Investigation of a SiC/Ti-24Al-11Nb composite [NASA-TM-100956] N88-28980

FIBER OPTICS
Long haul underwater fiber optic link [AD-A194487] N88-29542

FIBONACCI NUMBERS
Relaxed heaps: An alternative to fibonacci heaps [AD-A194030] N88-29470

FIBROSIS
Hierarchical structure in polymeric solids and its influence on properties [AD-A194720] N88-29029

FIELD EFFECT TRANSISTORS
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs [AD-A193462] N88-29080

FIELD THEORY (PHYSICS)
On the quantization of constrained generalized dynamics [DE88-702223] N88-29505
On neutrino fields in Einstein-Cartan theory [MATH-REPT-208] N88-29629

FIGHTER AIRCRAFT
Combat aircraft N88-28868
Inflight rearming [AD-A193564] N88-28909
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS) [NASA-CR-175104] N88-28917
Computers in weapons systems: A look at the F-15 [AD-A194498] N88-28920
General operational and training visual concerns N88-29295
Grid generation on and about a cranked-wing fighter aircraft configuration N88-29318
Grid generation for an advanced fighter aircraft N88-29319
Algebraic grid generation for fighter type aircraft N88-29320

FILAMENTS
Diamond film by hot filament CVD method [NASA-TT-20335] N88-29618

FILE MAINTENANCE (COMPUTERS)
The SMITE object oriented backing store [RSRE-MEMO-4147] N88-29308

FINE STRUCTURE
Can we calculate the fundamental dimensionless constants of physics [DE88-702641] N88-29625

FINITE DIFFERENCE THEORY
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system [DE88-009714] N88-28960

FINITE ELEMENT METHOD
Finite Element Composite Analysis Program (FECAP) for a microcomputer [NASA-TM-100670] N88-28982
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs [AD-A193462] N88-29080
Static and dynamic metal-metal friction at plastic stress levels [DE88-011281] N88-29176
Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels [DE88-701619] N88-29198
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems [AD-A193560] N88-29464
Investigation of the higher-order elements in the SAMSON2 code [AD-A193638] N88-29465

Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179686] N88-29480
Analysis of the transmission of sound into the passenger compartment of a propeller aircraft using the finite element method
[FFA-TN-1988-15] N88-29520

FINS
Feasibility study of a microprocessor controlled actuator fast mechanism
[AD-A194654] N88-29337

FIR FILTERS
Digital filter design techniques
[AD-A194484] N88-29486

FITTINGS
Expandable pallet for space station interface attachments
[NASA-CASE-MSC-21117-1] N88-28958

FLAME PROPAGATION
Combustion dynamics and thermal structure of a planar spray flame N88-28985

FLAME SPRAYING
Combustion dynamics and thermal structure of a planar spray flame N88-28985

FLAME TEMPERATURE
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924

FLAPS (CONTROL SURFACES)
Variable wing camber control systems for the future Airbus program
[MBB-UT-104/88] N88-28932

FLAT PLATES
Stability and drag reduction in a boundary layer with microbubbles
[AD-A191975] N88-29099

FLEXIBLE BODIES
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437

FLIGHT CONTROL
Improvement of head-up display standards. Volume 2: Evaluation of head-up displays to enhance unusual attitude recovery
[AD-A194601] N88-28921
Improvement of head-up display standards. Volume 5: Head up display ILS (Instrument Landing System) accuracy flight tests
[AD-A194602] N88-28922
Time periodic control of a multi-blade helicopter
[AD-A194435] N88-28931
Avionic expert systems N88-29365
Motion planning for a free-flying robot N88-29378

FLIGHT CREWS
Future air-to-air training for the RF-4
[AD-A194363] N88-29284

FLIGHT HAZARDS
Contributions to the modeling of wind shear for danger studies
[NASA-TT-20293] N88-28900

FLIGHT MECHANICS
Intelligent interfaces for expert systems N88-29397

FLIGHT SAFETY
UK airmisses involving commercial air transport
[CAA-1/88] N88-28907

FLIGHT SIMULATION
Complex configurations N88-28861
Contributions to the modeling of wind shear for danger studies
[NASA-TT-20293] N88-28900

FLIGHT SIMULATORS
OMV docking simulator N88-29379

FLIGHT TESTS
Proof-of-principle high speed electronic imaging system, phase 2
[AD-A193798] N88-28937
Two biased estimation techniques in linear regression: Application to aircraft
[NASA-TM-100649] N88-29489

FLIGHT TRAINING
Future air-to-air training for the RF-4
[AD-A194363] N88-29284
Proposed improvements to the USAF flight screening program
[AD-A194506] N88-29285

FLOW DISTRIBUTION
Experimental tools: The tunnel and the model N88-28864
Computational tools for simulation methodologies N88-28865
Transport-type configurations N88-28867
Combat aircraft N88-28868
Missiles, fuselages and similar bodies N88-28869
Introduction and critical flow phenomena N88-28870
Vortex flows N88-28875
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883
Unsteady flow past an NACA 0012 airfoil at high angles of attack
[AD-A194650] N88-28886
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28896
Flow visualization by laser sheet
[AD-A194481] N88-29111
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-180484] N88-29116
High effectiveness contour matching contact heat exchanger
[NASA-CASE-MSC-20840-1] N88-29132
Study of experimental technique of oil flow with emphasis on quantitative determination of the flow position parameters on the surface
[NASA-TT-20341] N88-29135
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow
[AD-A194479] N88-29162
Three-dimensional elliptic grid generation for an F-16 N88-29315
Component adaptive grid generation for aircraft configurations N88-29316
Generation of multiple block grids for arbitrary 3D geometries N88-29317
Grid generation for an advanced fighter aircraft N88-29319
Algebraic grid generation for fighter type aircraft N88-29320
Analytical surfaces and grids N88-29322
Grid generation around transport aircraft configurations using a multi-block structured computational domain N88-29325
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676

FLOW EQUATIONS
Accurate solutions, parameter studies and comparisons for the Euler and potential flow equations
[NASA-TM-100664] N88-28892
European research program on viscous flows
[DFVLR-AVA-IB-227-87-A-15] N88-29129

FLOW GEOMETRY
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114

FLOW MEASUREMENT
Reynolds number effects and the wind tunnel environment N88-28862
Construction of a laser Doppler anemometer and its use for the testing of a novel probe for the measurement of the variations of the lateral component of the vortex vector
[MPIS-13/1987] N88-29147

FLOW STABILITY
Boundary layer development and transition N88-28871

FLOW VELOCITY
Delta wing configurations N88-28860
Unsteady water channel
[AD-A194231] N88-28884

FLOW VISUALIZATION
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883
Three-dimensional vortex interactions
[AD-A194066] N88-28889
Flow visualization on a small scale
[AD-A194728] N88-28935
Flow visualization by laser sheet
[AD-A194481] N88-29111
Application of Particle Image Displacement Velocimetry (PIDV) to complex flows: Velocity field measurements in front of a heavy gas cloud
[VKI-TN-166] N88-29125
Study of experimental technique of oil flow with emphasis on quantitative determination of the flow position parameters on the surface
[NASA-TT-20341] N88-29135

FLUID FLOW
Study of experimental technique of oil flow with emphasis on quantitative determination of the flow position parameters on the surface
[NASA-TT-20341] N88-29135
Mapping of volcanic units at Alba Patera, Mars N88-29663
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676

FLUID JETS
The influence of delay effects on the decay of liquid jets
[MPIS-14/1987] N88-29130

FLUID MECHANICS
Three-dimensional vortex interactions
[AD-A194066] N88-28889
A limiting viscosity approach to the Riemann problem for materials exhibiting change of phase
[AD-A193477] N88-29103
Development of the Simplified Compressor Model (SCM) for performance analysis of gaseous diffusion compressors
[DE88-009066] N88-29173

FLUORESCENCE
Program to increase the measurement capabilities of the AFGL (Air Force Geophysics Laboratory) fixed and mobile high altitude lidar systems
[AD-A194614] N88-29063
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141

FLUORO COMPOUNDS
Polyazidoesters as energetic polymers and copolymer components with fluoro derivatives
[AD-A194236] N88-29039

FLUOROHYDROCARBONS
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088

FLUX DENSITY
Difficulties with interpretation of underground muons from Cygnus X-3
[DE88-701645] N88-29710

FOCUSING
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059

FOG
Flow visualization on a small scale
[AD-A194728] N88-28935

FORCED CONVECTION
Stability experimental results of cable-in-conduit superconductor for fusion
[DE88-753424] N88-29589

FORESTS
A linear-time algorithm for finding a minimum spanning pseudoforest
[AD-A194029] N88-29346

FORMULAS (MATHEMATICS)
Investigation of the higher-order elements in the SAMSON2 code
[AD-A193638] N88-29465

FORMULATIONS
Investigation of the higher-order elements in the SAMSON2 code
[AD-A193638] N88-29465

FORTRAN
A computer program package for introductory one-dimensional digital signal processing applications
[AD-A194656] N88-29338

FOURIER ANALYSIS
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962

FOURIER-BESSEL TRANSFORMATIONS
Solution of large order Fourier-Bessel equations
[ARE-TM(UHA)-88504] N88-29475

FRACTIONATION
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138
Crystal fractionation in the SNC meteorites: Implications for surface units on Mars N88-29698

FRACTURE MECHANICS
Wave and fracture phenomena in impacted ceramics
[AD-A192946] N88-29020
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193
Results on the influence of crack tip plasticity during dynamic crack growth
[AD-A193480] N88-29194
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
A technique for measuring area under a curve
[AD-A193559] N88-29483
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684

FRACTURE STRENGTH
Advanced processing and properties of high performance alloys
[AD-A193767] N88-29010
FRACTURES (MATERIALS)
Development of creep fracture modelling in ceramics
[PB88-202825] N88-29021
FRACTURING
Wave and fracture phenomena in impacted ceramics
[AD-A192946] N88-29020
FREE ELECTRON LASERS
Free electron lasers with small period wigglers
[DE88-011627] N88-29156
The NBS/NRL (National Bureau of Standards/Naval Research Laboratory) free electron laser facility
[AD-A194214] N88-29159
Analysis of free electron laser performance utilizing the National Bureau of Standards CW microtron
[AD-A194217] N88-29160
FREE FLIGHT
Proof-of-principle high speed electronic imaging system, phase 2
[AD-A193798] N88-28937
Motion planning for a free-flying robot N88-29378
FREE FLOW
Unsteady water channel
[AD-A194231] N88-28884
FRENCH SATELLITES
The heat pipe network of TDF-1/TV-SAT. Review of the development at completion
[SNIAS-881-440-103] N88-29127
FREQUENCIES
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061
FREQUENCY CONTROL
Three-dimensional vortex interactions
[AD-A194066] N88-28889
Reduction in mill air compressor power requirements through installation of a variable frequency speed control
[DE88-008493] N88-29171
FREQUENCY DISTRIBUTION
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise
[AD-A193865] N88-29492
FREQUENCY STABILITY
Three-dimensional vortex interactions
[AD-A194066] N88-28889
FRESNEL LENSES
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222
FRICTION
Development of high temperature, high pressure rotating shaft seals
[DE88-001029] N88-29172
FRONTS (METEOROLOGY)
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251
FUEL CELLS
Development of planar geometry solid oxide fuel cell technology, phase 1
[PB88-210356] N88-29215
FUEL COMBUSTION
Combustion studies of acoustically suspended liquid droplets
[AD-A193892] N88-28998
FUEL CONTAMINATION
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042
FUEL PUMPS
Two phase flow in a rotating screw tube (screw tube pump). Investigation of the function and efficiency of the screw tube pump
[MPIS-16/1987] N88-29178
FUELS
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
FUNCTIONAL ANALYSIS
Weak solution of the Langevin equation on a generalized functional space
[AD-A194290] N88-29456
FUNCTIONAL DESIGN SPECIFICATIONS
Formal specification of a secure document control system for SMITE
[RSRE-88002] N88-29309
FUNCTIONALS
On a class of functionals invariant under a Z(sup n) action
[AD-A193474] N88-29451
Practical higher-order functional and logic programming based on lambda-calculus and set-abstraction
[AD-A193645] N88-29466
Critical values of functionals on Banach surfaces
[DE88-702735] N88-29472
FUNCTIONS (MATHEMATICS)
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
Multicriteria integer programming for problems involving linear and nonlinear utility functions
[AD-A194530] N88-29336
FUSELAGES
Missiles, fuselage and similar bodies N88-28858
Missiles, fuselages and similar bodies N88-28869

G

GADOLINIUM
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR
[DE88-752611] N88-29588
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599
GALACTIC CLUSTERS
Clustering of galaxies and clusters of galaxies in a decaying-particle cosmological model with a massive decay product
[DE88-753434] N88-29642
Systematic properties of clusters of galaxies in different cosmological scenarios N88-29646
Catalog of open clusters and associated interstellar matter
[NASA-RP-1202] N88-29652
GALACTIC EVOLUTION
Molecular hydrogen in galaxies N88-29645
GALAXIES
Dynamics of interacting galaxies N88-29647
GALLIUM ARSENIDES
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs
[AD-A193462] N88-29080
Metal grid base heterojunction transistor operating at 60 and 94 GHz
[AD-A194763] N88-29087
The diamond as a new electronic material
[NASA-TT-20354] N88-29098
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595
Electrical conductivity of GaAs layers implanted on semi-insulator nondoped substrates
[CERT-422000/RF] N88-29614
GALLIUM PHOSPHIDES
Vibration spectra induced by impurities in 3-5-compounds semiconductors
[DE88-702730] N88-29610
GAME THEORY
Interactive, networked moving platform simulators
[AD-A192374] N88-28940
Stochastic game approach to guidance design
[AD-A194574] N88-29498
GAMMA RAY ASTRONOMY
Very high energy cosmic gamma rays from radio and X-ray pulsars N88-29711
GAMMA RAY LASERS
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165
GAMMA RAY SPECTROMETERS
Gamma-ray/neutron spectroscopy from the Mars observer N88-29671
GAMMA RAYS
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019
GARNETS
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599
GAS ANALYSIS
Method and device for determining heats of combustion of gaseous hydrocarbons
[NASA-CASE-LAR-13528-1] N88-29002
GAS ATOMIZATION
Theoretical and experimental investigations on the structure of stationary shock waves in gas particle dispersions
[ETN-88-92983] N88-29122
GAS DYNAMICS
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
GAS EXPLOSIONS
Application of Particle Image Displacement Velocimetry (PIDV) to complex flows: Velocity field measurements in front of a heavy gas cloud
[VKI-TN-166] N88-29125
GAS FLOW
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120
Modeling of pulsed gas flow lasers
[ESA-TT-1090] N88-29169
GAS LASERS
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166
GAS MIXTURES
An experimental setup for the study of polarized He3 and dilute He3-He4 mixtures
[B8705589] N88-29001
GAS TEMPERATURE
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120
GAS TURBINES
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program)
[AD-A193678] N88-28925
GAS-GAS INTERACTIONS
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
GASDYNAMIC LASERS
Modeling of pulsed gas flow lasers
[ESA-TT-1090] N88-29169
GASEOUS DIFFUSION
Development of the Simplified Compressor Model (SCM) for performance analysis of gaseous diffusion compressors
[DE88-009066] N88-29173
GASES
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024
The kinematics of Milky Way halo gas N88-29648
GASTROINTESTINAL SYSTEM
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29281
GAUGE THEORY
Theoretical particle physics
[DE88-011499] N88-29621
GAUSS EQUATION
Limiting distributions of non-linear vector functions of stationary Gaussian processes
[AD-A194589] N88-29488
GEARS
High hot-hardness gear lubricant evaluations, phase 2
[AD-A192309] N88-29017
GELS
Method of dispensing reagent chemicals in space
[NASA-CASE-LAR-13607-1-CU] N88-29048
GEOCHEMISTRY
MEVTV Workshop on Nature and Composition of Surface Units on Mars
[NASA-CR-183075] N88-29654
Mars: Spectral signatures seen and unseen N88-29659
Aqueous alteration in S-N-C meteorites and implications for weathering products on Mars N88-29673
GEODETIC SURVEYS
A comparison: Static and future kinematic GPS (Global Positioning System) surveys
[AD-A194666] N88-28904
GEOLOGICAL FAULTS
Mechanics of thrust fault formation N88-29229
GEOLOGY
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658
Intercrater plains deposits and the origin of Martian valleys N88-29661
Elemental composition of the Martian surface N88-29665
Distribution and timing of thick transient air-fall deposits in Electris: Implications for the nature of the upland plains N88-29674
Geology of six possible Martian landing sites N88-29682
Documenting volcano-tectonic episodes in Mars' stratigraphic record N88-29695
GEOMETRY
Delta wing configurations N88-28860
Ice detector
[NASA-CASE-LAR-13776-1] N88-29149
Cooperating knowledge-based systems
[NASA-CR-183109] N88-29327

Holomorphic geometry of interacting string
[DE88-702714] N88-29627

GEOMORPHOLOGY
MEVTV Workshop on Nature and Composition of Surface Units on Mars
[NASA-CR-183075] N88-29654
The history of Martian volcanism determined from a revised relative chronology N88-29657
Morphologic contrasts between Nirgal and Auqakuh Valles, Mars: Evidence of different crustal properties N88-29681
Geology of six possible Martian landing sites N88-29682
Stratigraphy of the Kasei Valles region, Mars N88-29690
High resolution Viking Orbiter images: A useful data source for testing the viability of geomorphic processes attributed to Martian landforms N88-29703

GEOPHYSICAL SATELLITES
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240

GEOPHYSICS
Program to increase the measurement capabilities of the AFGL (Air Force Geophysics Laboratory) fixed and mobile high altitude lidar systems
[AD-A194614] N88-29063

GEOTHERMAL RESOURCES
Unstable heat pipes
[DE88-010780] N88-29217

GERMANIUM
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

GERMANIUM COMPOUNDS
Photorefractive damage mechanism in electro-optic materials
[AD-A194560] N88-29543

GLASS
Metal halide optical glasses
[AD-A193794] N88-29032

GLASS FIBER REINFORCED PLASTICS
Development of a glass fiber wing following the construction regulation FAR Part 23
[ETN-88-92966] N88-28979

GLASS LASERS
Development of high efficiency q-switched glass laser via sol-gel processing
[AD-A192301] N88-29154

GLOBAL POSITIONING SYSTEM
Estimation forces acting on an underwater vehicle with G.P.S. (Global Positioning System) and Kalman filtering
[AD-A194339] N88-28901
Performance of GPS-aided INS during high-dynamic maneuvers
[AD-A194624] N88-28903
A comparison: Static and future kinematic GPS (Global Positioning System) surveys
[AD-A194666] N88-28904

GLOW DISCHARGES
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

GOLD
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986
Correlations between wettability and structure in monolayers of alkanethiols adsorbed on gold
[AD-A194348] N88-28991
Potential induced structural transformations of the Au(100) and Au(111) surfaces
[DE88-005446] N88-29571

GOVERNMENT/INDUSTRY RELATIONS
Argonne National Laboratory technology transfer report, FY87
[DE88-010091] N88-29639

GRADIENTS
The gradient method for interface tracking
[AD-A194477] N88-29334

GRAPHITE-EPOXY COMPOSITES
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-28968

GRATINGS (SPECTRA)
A theoretical and experimental investigation into the use of SAW weighting techniques in optical diffraction gratings
[RSRE-MEMO-4128] N88-29549

GRAVITATION
Towards a finite quantum gravity
[DE88-701497] N88-29619

GRAVITATIONAL FIELDS
Gravitational redshift of self-gravitating systems of dark matter in the universe
[DE88-702688] N88-29650

GRAVITATIONAL WAVES
Acoustic-optical detector of gravitational waves based on high-quality crystals
[DE88-702459] N88-29232
On the degenerate Ferrari-Ibanez solution for colliding plane gravitational waves
[MATH-REPT-209] N88-29630

GREEN'S FUNCTIONS
Green's function approach to roughening transition of one-dimensional restricted solid on solid model
[DE88-702723] N88-29512

GREENHOUSE EFFECT
Episodic vs. epochal release of SO2 on Mars N88-29688

GREENLAND
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251

GRID GENERATION (MATHEMATICS)
Three dimensional grid generation for complex configurations: Recent progress
[AGARD-AG-309] N88-29313
Lessons learned in the mesh generation for PN/S calculations N88-29314
Three-dimensional elliptic grid generation for an F-16 N88-29315
Component adaptive grid generation for aircraft configurations N88-29316
Generation of multiple block grids for arbitrary 3D geometries N88-29317
Grid generation on and about a cranked-wing fighter aircraft configuration N88-29318
Grid generation for an advanced fighter aircraft N88-29319
Algebraic grid generation for fighter type aircraft N88-29320
Composite grid generation for aircraft configurations with the EAGLE code N88-29321
Analytical surfaces and grids N88-29322
Mesh generation for industrial application of Euler and Navier Stokes solvers N88-29323
Experience with three dimensional composite grids N88-29324
Grid generation around transport aircraft configurations using a multi-block structured computational domain N88-29325

GROUND STATE
Measurements of XeF (Xenon Fluoride) ground state dissociation and vibrational equilibration
[AD-A194611] N88-29527

GROUP THEORY
Invariant ideals of multiplicity free algebraic group actions
[B8803517] N88-29509

GROWTH
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600

GUIDANCE (MOTION)
Approximations and implementations of nonlinear filtering schemes
[AD-A194685] N88-29482
Stochastic game approach to guidance design
[AD-A194574] N88-29498

H

HADRONS
Hadrons produced in atmospheric interactions
[DE88-702492] N88-29712

HALL EFFECT
DARPA-URI consortium meetings on submicron heterostructures of diluted magnetic semiconductors
[AD-A193499] N88-29081
Temperature dependence of conductivity and of Hall coefficient . for noble metal films
[ETN-88-92961] N88-29616

HAMILTONIAN FUNCTIONS
A minimax method for a class of Hamiltonian systems with singular potentials
[AD-A193478] N88-29453
Periodic solutions of perturbed superquadratic Hamiltonian systems
[AD-A194292] N88-29457
On the periodic nonlinearity and the multiplicity of solutions
[AD-A194295] N88-29459
Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: Numerical and analytical results
[DE88-702747] N88-29473

HARMONIC GENERATORS
Frequency doubling at 1.315 micrometers
[AD-A193902] N88-29092

HARMONICS
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275

HEAD-UP DISPLAYS
Improvement of head-up display standards. Volume 2: Evaluation of head-up displays to enhance unusual attitude recovery
[AD-A194601] N88-28921
Improvement of head-up display standards. Volume 5: Head up display ILS (Instrument Landing System) accuracy flight tests
[AD-A194602] N88-28922
Vision through aircraft transparencies N88-29294
Maintenance of vision-related components N88-29296
Display system image quality N88-29298

HEART RATE
Effects of psychophysical lifting training on maximal repetitive lifting capacity
[AD-A192605] N88-29271

HEAT EXCHANGERS
High effectiveness contour matching contact heat exchanger
[NASA-CASE-MSC-20840-1] N88-29132

HEAT MEASUREMENT
Method and device for determining heats of combustion of gaseous hydrocarbons
[NASA-CASE-LAR-13528-1] N88-29002

HEAT OF COMBUSTION
Method and device for determining heats of combustion of gaseous hydrocarbons
[NASA-CASE-LAR-13528-1] N88-29002

HEAT PIPES
The heat pipe network of TDF-1/TV-SAT. Review of the development at completion
[SNIAS-881-440-103] N88-29127
Development of a space deployable radiator using heat pipes
[SNIAS-881-440-104] N88-29128
Polymeric heat pipe wick
[NASA-CASE-GSC-13019-1] N88-29133
Unstable heat pipes
[DE88-010780] N88-29217

HEAT PUMPS
Absorption heat pumps
[DE88-752820] N88-29218

HEAT RESISTANT ALLOYS
Advanced processing and properties of high performance alloys
[AD-A193767] N88-29010

HEAT SOURCES
High temperature electric arc furnace
[NASA-CASE-MFS-28281-1] N88-28938

HEAT STORAGE
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28960

HEAT TRANSFER
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179488] N88-28930
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28960
Combustion dynamics and thermal structure of a planar spray flame N88-28985
Numerical investigations in three-dimensional internal flows
[NASA-CR-183108] N88-29106

HEAT TRANSFER COEFFICIENTS
Estimation of transient heat transfer coefficients in multidimensional problems by using inverse heat transfer methods N88-29108

HEATING
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151

HELICOPTERS
Investigation of helicopter rotor blade/wake interactive impulsive noise
[NASA-CR-177435] N88-28882

HELIUM
An upper limit on the primordial He4 abundance from speckle interferometric observations of muon Cassiopeiae N88-29641

HELMET MOUNTED DISPLAYS
Display system image quality N88-29298
HEMODYNAMIC RESPONSES
Human performance and acute hypoxia, chapter 12 [AD-A192604] N88-29270
HERMES MANNED SPACEPLANE
Ariane 5, HERMES and European vehicles for space station servicing [SNIAS-881-422-102] N88-28943
HERMETIC SEALS
Sinterable ceramic powders from laser-heated gases [AD-A194162] N88-29024
HETEROJUNCTION DEVICES
Theoretical investigation on heterojunction solar cell [DE88-701837] N88-29219
HETEROJUNCTIONS
Metal grid base heterojunction transistor operating at 60 and 94 GHz [AD-A194763] N88-29087
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques [DE88-008560] N88-29582
HEURISTIC METHODS
An approach to combining heuristic and qualitative reasoning in an expert system N88-29362
NOA: A Network Operator Assistant for scheduling Tracking and Data Relay Satellite System (TDRSS) N88-29403
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437
HF LASERS
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow [AD-A194479] N88-29162
HIERARCHIES
Hierarchical organization for large, dynamic radio networks [AD-A193942] N88-29067
Motion planning for legged locomotion systems on uneven terrain N88-29170
HIGH ALTITUDE ENVIRONMENTS
Alterations in upper extremity motor function in soldiers during acute high altitude exposure [AD-A192676] N88-29272
HIGH ENERGY INTERACTIONS
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration [AD-A193825] N88-29164
Theoretical studies in high energy physics [DE88-011606] N88-29538
HIGH LEVEL LANGUAGES
Investigation of the use of High Order Languages (HOLs) for on-board software [CRI/FR/HOL-C/1/87] N88-29349
Archetyping: A software generation and management methodology N88-29382
The FORCE [AD-A193463] N88-29429
Strategic defense initiative architecture dataflow modeling technique version 1.5 [AD-A194356] N88-29494
HIGH POWER LASERS
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration [AD-A193825] N88-29164
HIGH PRESSURE
E3 10C compressor test analysis of high-speed post-stall data [NASA-CR-179521] N88-28929
Development of high temperature, high pressure rotating shaft seals [DE88-001029] N88-29172
HIGH PRESSURE OXYGEN
USAF hyperbaric animal transfer chamber system [AD-A193633] N88-29265
HIGH RESOLUTION
High definition television: Evaluation for remote task performance [DE88-011573] N88-29057
Signal processing software for ground penetrating radar, user's manual [AD-A194286] N88-29059
HIGH SPEED
E3 10C compressor test analysis of high-speed post-stall data [NASA-CR-179521] N88-28929
Proof-of-principle high speed electronic imaging system, phase 2 [AD-A193798] N88-28937
HIGH STRENGTH ALLOYS
Evaluation of a diffusion/trapping model for hydrogen ingress in high-strength alloys [AD-A194301] N88-29008
HIGH TEMPERATURE
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites [UTIAS-324] N88-28970
The high temperature creep deformation of Si3N4-5Y2O3-2Al2O3 [NASA-CR-183204] N88-28981
A fundamental study of P/M processed elevated temperature aluminum alloys [AD-A192958] N88-29005
Development of high temperature, high pressure rotating shaft seals [DE88-001029] N88-29172
HIGH TEMPERATURE LUBRICANTS
High hot-hardness gear lubricant evaluations, phase 2 [AD-A192309] N88-29017
HIGH TEMPERATURE PLASMAS
Apparatus for submillimeter laser diagnostics of high-temperature plasma [DE88-702464] N88-29563
HIGH TEMPERATURE SUPERCONDUCTORS
La2CuO(sub 4 + delta): A superconducting superoxide [DE88-010325] N88-29578
Dependence of high critical temperature of ceramic superconductors on the nominal Cu(sup 3+)Cu(sup 2+) ratio [DE88-702734] N88-29611
HIGHLANDS
Topography of large craters on Mars: Implications for the highlands resurfacing history N88-29691
Ridged and gullied terrains in the Martian uplands N88-29700
HILBERT SPACE
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r [AD-A193510] N88-29506
The Hilbert space of the open bosonic string [USIP-88-02] N88-29628
HISTORIES
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2 [DE88-010416] N88-29248
SDI (Strategic Defense Initiative): A policy analysis [AD-A194240] N88-29493
An introduction to the historical records of China about Mars N88-29664
HOLDERS
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119 [NASA-CR-179020] N88-29184
HOLMIUM
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR [DE88-752611] N88-29588
HOLOGRAPHY
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields [AD-A194191] N88-28883
Hologram representation of design data in an expert system knowledge base N88-29354
HOT ELECTRONS
Hot electron emission in semiconductors [AD-A194101] N88-29601
HOT SURFACES
Diamond film by hot filament CVD method [NASA-TT-20335] N88-29618
HOT-WIRE FLOWMETERS
On experiences with two hot-wire instruments for measuring the liquid water content in clouds [ESA-TT-1085] N88-29255
HUBBLE SPACE TELESCOPE
Automated generation of spacecraft activity plans N88-29396
HUMAN BEHAVIOR
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training [AD-A194777] N88-29274
HUMAN BEINGS
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance [AD-A193815] N88-29143
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz [AD-A191977] N88-29268
Human auditory and visual continuous evoked potentials N88-29269
Limits of pattern discrimination in human vision [AD-A193449] N88-29273
Methods and instrumentation for biomagnetism [AD-A193811] N88-29278
Visual motion perception and visual attentive processes [AD-A193640] N88-29288
HUMAN FACTORS ENGINEERING
Visual Effects in the High Performance Aircraft Cockpit [AGARD-LS-156] N88-29291
HUMAN PERFORMANCE
Human performance and acute hypoxia, chapter 12 [AD-A192604] N88-29270
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification [AD-A193558] N88-29287
HUMIDITY
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities [DE88-010870] N88-29138
HYDROCARBONS
Method and device for determining heats of combustion of gaseous hydrocarbons [NASA-CASE-LAR-13528-1] N88-29002
Nonseismic, surface geophysical and geochemical prospecting technology [PB88-196613] N88-29207
HYDRODYNAMICS
Nonseismic, surface geophysical and geochemical prospecting technology [PB88-196613] N88-29207
Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments [DE88-010202] N88-29329
HYDROGEN
Hydrogen storage by molecular polyhydrides [AD-A194207] N88-28989
Measure of hydrogen concentration profile in materials by resonant nuclear reactions [DE88-702599] N88-28999
Hydrogen permeation through metallic foils [DE88-702600] N88-29000
Kinetic of martensitic transformations induced by hydrogen in the austenite [DE88-701623] N88-29007
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow [AD-A194493] N88-29163
Chemical kinetics of hydrogen and P(sub b) centers [DE88-010528] N88-29594
Theoretical investigation of image states of the hydrogen covered Cu (100) [DE88-702662] N88-29604
HYDROGEN ATOMS
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases [AD-A193881] N88-28997
HYDROGEN EMBRITTLEMENT
Evaluation of a diffusion/trapping model for hydrogen ingress in high-strength alloys [AD-A194301] N88-29008
HYPERBARIC CHAMBERS
USAF hyperbaric animal transfer chamber system [AD-A193633] N88-29265
HYPERBOLIC FUNCTIONS
Stability of semidiscrete approximations for hyperbolic initial-boundary-value problems: Stationary modes [NASA-TM-100994] N88-29455
HYPERCUBE MULTIPROCESSORS
Solving the symmetric tridiagonal eigenvalue problem on the hypercube [AD-A193905] N88-29344
A performance study of the hypercube architecture [AD-A194361] N88-29433
HYPERSONIC FLOW
Fellowships in hypersonic aerodynamics [AD-A194265] N88-28885
A numerical study of the test time in a hypersonic shock tunnel [AD-A194057] N88-28888
HYPERSONIC REENTRY
Study of hypersonic boundary layers [CERT-RSF-OA-17/5005-AYD] N88-29121
HYPERSONIC SHOCK
A numerical study of the test time in a hypersonic shock tunnel [AD-A194057] N88-28888
HYPERSONIC SPEED
Fellowships in hypersonic aerodynamics [AD-A194265] N88-28885
HYPERSONIC VEHICLES
Fellowships in hypersonic aerodynamics [AD-A194265] N88-28885

HYPERSONIC WIND TUNNELS
A numerical study of the test time in a hypersonic shock tunnel
[AD-A194057] N88-28888
HYPERTHERMIA
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
HYPOXIA
Human performance and acute hypoxia, chapter 12
[AD-A192604] N88-29270
HYSTERESIS
Mathematical theory and calculations of magnetic hysteresis curves
[DE88-011055] N88-29510

I

ICE
Ice detector
[NASA-CASE-LAR-13776-1] N88-29149
ICELAND
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251
ICOSAHEDRONS
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193768] N88-29011
IGNEOUS ROCKS
Weathering of sulfides on Mars N88-29682
Volcano evolution on Mars N88-29686
IGNITION
Combustion dynamics and thermal structure of a planar spray flame N88-28985
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29046
ILLUMINATING
Maintenance of vision-related components N88-29296
Night lighting and night vision goggle compatibility N88-29297
IMAGE ANALYSIS
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis
[AD-A192399] N88-29208
IMAGE PROCESSING
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883
Three-dimensional vortex interactions
[AD-A194066] N88-28889
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288
Automatic object recognition N88-29368
Two dimensional convolute integers for machine vision and image recognition N88-29369
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487
IMAGE RESOLUTION
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
High definition television: Evaluation for remote task performance
[DE88-011573] N88-29057
IMAGERY
Determining vehicle motion from stereo image sequences
[AD-A194371] N88-29140
IMAGES
Transformations of short-term visual memory
[AD-A193873] N88-29290
IMAGING TECHNIQUES
Proof-of-principle high speed electronic imaging system, phase 2
[AD-A193798] N88-28937
Visual Effects in the High Performance Aircraft Cockpit
[AGARD-LS-156] N88-29291
Display system image quality N88-29298
Optimization-driven machine-oriented motion measurement N88-29312
IMINES
Polymerization of azaethylenes (imines) and aza-1,3-dienes: Potential reactive monomers
[AD-A194717] N88-29028
IMPACT DAMAGE
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-28959
Wave and fracture phenomena in impacted ceramics
[AD-A192946] N88-29020
IMPEDANCE
Power supply conditioning circuit
[NASA-CASE-NPO-17233-1-CU] N88-29095
IMPURITIES
Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum hydroxide
[NASA-TT-20332] N88-29003
Vibration spectra induced by impurities in 3-5-compounds semiconductors
[DE88-702730] N88-29610
INCIDENCE
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence
[FFA-TN-1988-02] N88-29126
INCOMPRESSIBLE FLOW
Steady and unsteady internal flow computations via the solution of the compressible Navier Stokes equations for low Mach numbers N88-29100
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method
[AD-A193479] N88-29104
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
INDEPENDENT VARIABLES
A minitab macro for the Kaplan-Meier product limit estimator and the Tarone-Ware class of tests
[AD-A194298] N88-29331
A nonparametric multidimensional IRT approach with applications to ability estimation and test bias
[AD-A194212] N88-29483
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
INDIAN OCEAN
Indian Ocean validation
[AD-A194458] N88-28902
INDIUM
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92985] N88-29617
INDUCTANCE
Linear thyratron
[AD-A194111] N88-29094
INDUSTRIES
Absorption heat pumps
[DE88-752820] N88-29218
INELASTIC SCATTERING
Effect of a laser field in the electron inelastic scattering into plasma fields
[DE88-702295] N88-29157
On selection rules and inelastic electron scattering at intermediate energies
[DE88-701833] N88-29526
INERTIAL NAVIGATION
Performance of GPS-aided INS during high-dynamic maneuvers
[AD-A194624] N88-28903
INFERENCE
Topics in adaptive control and inference
[AD-A194718] N88-29443
INFORMATION DISSEMINATION
Flight information publication (FLIP) feedback
[AD-A194462] N88-28897
INFORMATION FLOW
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432
INFORMATION PROCESSING (BIOLOGY)
Transformations of short-term visual memory
[AD-A193873] N88-29290
INFORMATION RETRIEVAL
Distributed knowledge base systems for diagnosis and information retrieval
[AD-A193107] N88-29633
Experiments in automatic phrase indexing for document retrieval: A comparison of syntactic and non-syntactic methods N88-29634
INFORMATION SYSTEMS
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247
Advanced information processing system: Input/output network management software
[NASA-CR-181678] N88-29431
Experiments in automatic phrase indexing for document retrieval: A comparison of syntactic and non-syntactic methods N88-29634
INFORMATION THEORY
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29448
INFRARED ASTRONOMY
Study of a safe attitude for the Infrared Space Observatory (ISO) during perigee pass
[SNIAS-881-440-113] N88-28954
INFRARED DETECTORS
Infrared detection using Rydberg atoms
[AD-A194308] N88-28990
Evaluation of atmospheric effects for operational tactical decision aid
[AD-A194205] N88-29236
Multi-sensory tracking mount control
[AD-A194675] N88-29339
INFRARED IMAGERY
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
INFRARED RADIATION
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166
Miniature respiratory sensor
[AD-A193430] N88-29300
INHIBITORS
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266
INITIATORS (EXPLOSIVES)
Development and verification of NASA Standard Initiator-2 (NSI-2)
[NASA-CR-172069] N88-29044
Development and verification of NASA Standard Initiator-2 (NSI-2): Appendix
[NASA-CR-172070] N88-29045
INLET FLOW
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
INLET NOZZLES
Rotation symmetric inside flow with diametric expansion resolution
[ILR-MITT-193] N88-29123
INLET PRESSURE
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
INPUT/OUTPUT ROUTINES
A proof of the Kahn principle for input/output automata
[AD-A194454] N88-29333
INSOLATION
Global solar radiation in Sierra Leone (West Africa)
[DE88-702725] N88-29252
INSTRUMENT LANDING SYSTEMS
Improvement of head-up display standards. Volume 5: Head up display ILS (Instrument Landing System) accuracy flight tests
[AD-A194602] N88-28922
INTEGERS
Multicriteria integer programming for problems involving linear and nonlinear utility functions
[AD-A194530] N88-29336
Two dimensional convolute integers for machine vision and image recognition N88-29369
Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: Numerical and analytical results
[DE88-702747] N88-29473
INTEGRAL EQUATIONS
An integral equation for the linearized unsteady supersonic flow over a wing
[AD-A193773] N88-28887
Resonance excitation of linear and non-linear spiral density waves in a gaseous disk N88-29643
INTEGRALS
An asymptotic evaluation of the tail of a multiple symmetric alpha-stable integral
[AD-A194570] N88-29460
INTEGRATED OPTICS
Investigations on periodically perturbed optical waveguides
[B8712725] N88-29548

INTELLIGENCE
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed
[AD-A193779] N88-29289
INTERACTIONAL AERODYNAMICS
An unsteady helicopter rotor: Fuselage interaction analysis
[NASA-CR-4178] N88-28880
Experience with three dimensional composite grids N88-29324
INTERACTIONS
Process migration in UNIX environments
[NASA-CR-182951] N88-29311
INTERACTIVE CONTROL
Mesh generation for industrial application of Euler and Navier Stokes solvers N88-29323
INTERFACES
Expandable pallet for space station interface attachments
[NASA-CASE-MSC-21117-1] N88-28958
Elastic behavior of a rubber layer bonded between two rigid spheres
[AD-A193698] N88-29030
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
The gradient method for interface tracking
[AD-A194477] N88-29334
INTERFACIAL TENSION
Orbital Propulsion Module (OPM). Study on coni-spherical surface tension tanks (COSTA)
[MBB-URV-170/87] N88-28963
Surface Tension Confined Liquid Cryogen Cooler (STCLCC)
[NASA-CASE-GSC-13112-1] N88-29050
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577
INTERNATIONAL RELATIONS
SDI (Strategic Defense Initiative). Where do we go from here
[AD-A194544] N88-29497
INTERNATIONAL SUN EARTH EXPLORERS
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947
INTERPOLATION
Analytical surfaces and grids N88-29322
Radial basis functions, multi-variable functional interpolation and adaptive networks
[RSRE-MEMO-4148] N88-29436
INTERPROCESSOR COMMUNICATION
Random-access algorithms for environments with capture
[AD-A194303] N88-29060
Process migration in UNIX environments
[NASA-CR-182951] N88-29311
INTERSTELLAR MATTER
Catalog of open clusters and associated interstellar matter
[NASA-RP-1202] N88-29652
INTERVERTEBRAL DISKS
Hierarchical structure in polymeric solids and its influence on properties
[AD-A194720] N88-29029
INVARIANCE
A nonparametric multidimensional IRT approach with applications to ability estimation and test bias
[AD-A194212] N88-29483
Invariant ideals of multiplicity free algebraic group actions
[88803517] N88-29509
Non-linear scale invariance in a cold-dark-matter universe
[DE88-011725] N88-29644
INVENTORY MANAGEMENT
A robotic system for automation of logistics functions on the Space Station N88-29407
IO
The interaction of Io with the plasma torus N88-29704
IODINE LASERS
Frequency doubling at 1.315 micrometers
[AD-A193902] N88-29092
ION ACCELERATORS
Plasma theory and simulation
[AD-A194674] N88-29565
ION BEAMS
Plasmoid propagation
[AD-A192378] N88-29555
Nonlinear analysis of non-neutral plasmas
[AD-A192506] N88-29556
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
ION CHARGE
Measurements of vacuum arc ion charge state distributions
[DE88-008249] N88-29558
ION CURRENTS
Polymeric electrolytes
[AD-A193766] N88-29031
ION DISTRIBUTION
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947
ION IMPLANTATION
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591
Electrical conductivity of GaAs layers implanted on semi-insulator nondoped substrates
[CERT-422000/RF] N88-29614
ION TEMPERATURE
Collector and source sheaths of a finite ion temperature plasma
[DE88-008934] N88-29584
IONIC MOBILITY
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
IONIZATION
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168
Electron impact ionization cross-section of some organic compounds
[DE88-702044] N88-29525
The kinematics of Milky Way halo gas N88-29648
IONIZATION CROSS SECTIONS
Electron impact ionization cross-section of some organic compounds
[DE88-702044] N88-29525
IONIZING RADIATION
Stress corrosion of ceramic materials
[AD-A191979] N88-29018
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267
IONOSONDES
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194246] N88-29237
IONOSPHERIC DRIFT
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194246] N88-29237
IONOSPHERIC ELECTRON DENSITY
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 2: Molecular ions (N2(+), NO(+), O2(+)) and electron density
[DFVLR-FB-88-12-PT-2] N88-29242
IONOSPHERIC ION DENSITY
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 1: Atomic ions (H(+), He(+), N(+), O(+))
[DFVLR-FB-88-11-PT-1] N88-29241
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 2: Molecular ions (N2(+), NO(+), O2(+)) and electron density
[DFVLR-FB-88-12-PT-2] N88-29242
IONOSPHERIC SOUNDING
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 1: Atomic ions (H(+), He(+), N(+), O(+))
[DFVLR-FB-88-11-PT-1] N88-29241
IONS
Hydrogen concentration cells as converters of heat into electricity
[DE88-009662] N88-29216
IRRADIANCE
Short term variability between 120 and 300 mm from Solar Mesosphere Explorer (SME) observations
[AERONOMICA-ACTA-A-328-1988] N88-29709
IRRADIATION
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
ISOPARAMETRIC FINITE ELEMENTS
Investigation of the higher-order elements in the SAMSON2 code
[AD-A193638] N88-29465
ITERATIVE SOLUTION
Grid generation around transport aircraft configurations using a multi-block structured computational domain N88-29325

J

J INTEGRAL
J-integral measurement using moire interferometry
[AD-A193751] N88-29202
JAMMING
Distortions in processed signals and their application in electronic design. Part 3: An automated generator of communication jamming signals
[DE88-702733] N88-29072
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166
JET AIRCRAFT NOISE
Noise levels from a jet-engined aircraft measured at ground level and at 1.2 m above the ground
[NPL-AC-114] N88-29524
JET ENGINE FUELS
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042
JET FLOW
A numerical study of turbulent plane jets in still and flowing environments employing two-equation k-epsilon model N88-29109
The influence of delay effects on the decay of liquid jets
[MPIS-14/1987] N88-29130
JET MIXING FLOW
Three-dimensional vortex interactions
[AD-A194066] N88-28889
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994
JOINTS (JUNCTIONS)
Critical joints in large composite primary aircraft structures. Volume 2: Technology demonstration test report
[NASA-CR-172587] N88-28915
Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results
[NASA-CR-172588] N88-28916
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
Critical joints in large composite primary aircraft structures. Volume 1: Technical summary
[NASA-CR-3914] N88-28983
Elastic behavior of a rubber layer bonded between two rigid spheres
[AD-A193698] N88-29030
Stability control of leakage flow channels
[DE88-009995] N88-29107
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics
[NASA-CR-182516] N88-29328
JOSEPHSON JUNCTIONS
Phase sensitive amplification with SIS (Superconductor-Insulator-Superconductor) quasiparticle mixers
[AD-A194594] N88-29596
Planar thin film SQUID with integral flux concentrator
[NASA-CASE-MFS-28282-1] N88-29602
JOUKOWSKI TRANSFORMATION
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110

K

K-EPSILON TURBULENCE MODEL
A numerical study of turbulent plane jets in still and flowing environments employing two-equation k-epsilon model N88-29109
KALMAN FILTERS
Estimation forces acting on an underwater vehicle with G.P.S. (Global Positioning System) and Kalman filtering
[AD-A194339] N88-28901
Estimation of aircraft parameters using filter error methods and extended Kalman filter
[DFVLR-FB-88-15] N88-28911
Multi-sensory tracking mount control
[AD-A194675] N88-29339
KEELS
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517
KEVLAR (TRADEMARK)
Nondestructive tests and high performance composite structures
[SNIAS-881-430-119] N88-28969
KINEMATICS
A comparison: Static and future kinematic GPS (Global Positioning System) surveys
[AD-A194866] N88-28904

Shock waves in unsteady flows
[NASA-TT-20329] N88-29134
Sea ice processes
[AD-A193980] N88-29262
The kinematics of Milky Way halo gas N88-29648
A review: Quantitative models for lava flows on Mars N88-29656

KINETIC HEATING
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024

KINETIC THEORY
Kinetic theory for electrostatic waves due to transverse velocity shears
[AD-A193404] N88-29557

KINETICS
Sol-gel kinetics: Si(sup)29 NMR and a statistical reaction model
[DE88-011545] N88-28988
Kinetic of martensitic transformations induced by hydrogen in the austenite
[DE88-701623] N88-29007
Reaction-theoretical aspects of the thermal behavior of lubricating oils and working fluids
[NASA-TT-20304] N88-29041
Chemical kinetics of hydrogen and P(sub b) centers
[DE88-010528] N88-29594

KNOWLEDGE
A model of information growth N88-29440

KNOWLEDGE REPRESENTATION
Cooperating knowledge-based systems
[NASA-CR-183109] N88-29327
Hologram representation of design data in an expert system knowledge base N88-29354
Knowledge-based fault diagnosis on future space vehicles N88-29374
AI and simulation: What can they learn from each other N88-29391
Knowledge acquisition and rapid protyping of an expert system: Dealing with real world problems N88-29394
Requirements for a tool to aid in the development of expert systems for space station applications N88-29398
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413
Semantic based man-machine interface for real-time communication N88-29421
Distributed knowledge base systems for diagnosis and information retrieval
[AD-A193107] N88-29633

L

LAMB WAVES
Relativistic theory of the Lamb shift based on self energy
[DE88-702658] N88-29626

LAMINAR BOUNDARY LAYER
Techniques for boundary layer tripping and control N88-28863

LAMINAR FLOW
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task
[NASA-CR-3992] N88-28894

LAMINAR WAKES
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112

LAMINATES
Elastic wave dispersion in laminated composite plate
[AD-A192289] N88-28967
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-28968

LANDING SIMULATION
Automatic landing by computer vision
[ETN-88-92991] N88-28905
Additional investigations into the aircraft landing process: Test distributions
[ESA-TT-1099] N88-28913

LANGEVIN FORMULA
Weak solution of the Langevin equation on a generalized functional space
[AD-A194290] N88-29456

LANTHANUM
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137

LANTHANUM OXIDES
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems
[DE88-702060] N88-29576
La2CuO(sub 4 + delta): A superconducting superoxide
[DE88-010325] N88-29578

LASER APPLICATIONS
Laser and electrochemical studies of metallizations in electronic devices
[AD-A193796] N88-29090
Flow visualization by laser sheet
[AD-A194481] N88-29111
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow
[AD-A194493] N88-29163

LASER BEAMS
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152

LASER DAMAGE
Spallation and dynamic fracture as an effect of laser induced shock-waves
[AD-A193513] N88-28971

LASER DOPPLER VELOCIMETERS
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936
Three-dimensional laser Doppler velocimeter studies of flow in a 90 deg curved duct having a square cross-section N88-29101
Construction of a laser Doppler anemometer and its use for the testing of a novel probe for the measurement of the variations of the lateral component of the vortex vector
[MPIS-13/1987] N88-29147

LASER OUTPUTS
Frequency doubling at 1.315 micrometers
[AD-A193902] N88-29092
Flow visualization by laser sheet
[AD-A194481] N88-29111
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
Effect of a laser field in the electron inelastic scattering into plasma fields
[DE88-702295] N88-29157
Analysis of free electron laser performance utilizing the National Bureau of Standards CW microtron
[AD-A194217] N88-29160
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration
[AD-A193825] N88-29164
Evidence for laser emission from the TICT exciplex of coumarin dyes
[DE88-702544] N88-29167

LASER PLASMAS
Introduction to laser plasma diagnostics
[DE88-011056] N88-29560
Apparatus for submillimeter laser diagnostics of high-temperature plasma
[DE88-702464] N88-29563
Modeling of atomic processes in X-ray laser plasmas
[AD-A194118] N88-29567

LASER SPECTROMETERS
The 1965-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226

LASER STABILITY
Analysis of free electron laser performance utilizing the National Bureau of Standards CW microtron
[AD-A194217] N88-29160

LASER TARGET INTERACTIONS
Spallation and dynamic fracture as an effect of laser induced shock-waves
[AD-A193513] N88-28971

LASER TARGETS
LLE (Laboratory for Laser Energetics) review
[DE88-008065] N88-29158

LASER WEAPONS
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan
[AD-A194357] N88-29495

LASERS
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972

LAUNCH VEHICLES
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194625] N88-28941
Wind measurements by electromagnetic probes
[NASA-TM-4066] N88-29256

LAVA
A review: Quantitative models for lava flows on Mars N88-29656
Mapping of volcanic units at Alba Patera, Mars N88-29663
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676

LEAD (METAL)
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137

LEAKAGE
Stability control of leakage flow channels
[DE88-009995] N88-29107

LEARNING
Effect of hypoxia on speech recognition in noise
[AD-A193943] N88-29280
Some learnability results for analogical generation
[AD-A193669] N88-29342
Design of a feeling-thinking machine
[AD-A194107] N88-29448

LEARNING MACHINES
Radial basis functions, multi-variable functional interpolation and adaptive networks
[RSRE-MEMO-4148] N88-29436
Active explanation reduction: An approach to the multiple explanations problem
[AD-A194127] N88-29501

LEARNING THEORY
Topics in adaptive control and inference
[AD-A194718] N88-29443

LEAST SQUARES METHOD
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064

LEG (ANATOMY)
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268

LEVEL (QUANTITY)
Exact lower confidence limits for the reliability of k of n systems for zero failures and nonconservativeness of the maximus method
[AD-A194299] N88-29485

LIFE (DURABILITY)
Influence of the temperature-dependence of recombination life-time of free carriers in amorphous semiconductors on thermostimulated photocurrent spectra
[DE88-702728] N88-29609

LIFE SUPPORT SYSTEMS
ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29380

LIFT
Effects of psychophysical lifting training on maximal repetitive lifting capacity
[AD-A192605] N88-29271

LIFTING BODIES
Fellowships in hypersonic aerodynamics
[AD-A194265] N88-28885

LIGHT EMISSION
Optical emission behavior and radiation resistance of epoxy resins
[DE88-752629] N88-29023
Optical emission from surface waves supported in thin metal films N88-29540

LIGHT SCATTERING
Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547

LIGHT TRANSMISSION
Metal halide optical glasses
[AD-A193794] N88-29032

LIGHTNING
Investigations into the triggered lightning response of the F106B thunderstorm research aircraft
[NASA-CR-3902] N88-29258
The 1983 direct strike lightning data, part 1
[NASA-TM-86426-PT-1] N88-29259
The 1983 direct strike lightning data, part 2
[NASA-TM-86426-PT-2] N88-29260
The 1983 direct strike lightning data, part 3
[NASA-TM-86426-PT-3] N88-29261

LIMITERS (FUSION REACTORS)
Tokamak plasma interaction with limiters
[UTIAS-325] N88-29586

LIMITS (MATHEMATICS)
Approximations and implementations of nonlinear filtering schemes
[AD-A194685] N88-29462

LINE SPECTRA
On selection rules and inelastic electron scattering at intermediate energies
[DE88-701833] N88-29526

LINEAR OPERATORS
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics
[NASA-CR-182516] N88-29328

LINEAR PREDICTION
Two biased estimation techniques in linear regression: Application to aircraft
[NASA-TM-100649] N88-29489

LINEAR SYSTEMS
Linear thyratron
[AD-A194111] N88-29094
Improved finite strip Mindlin plate bending element using assumed shear strain distributions
[NASA-TM-100928] N88-29195
Robust control of multivariable and large scale systems
[AD-A194250] N88-29441
Topics in adaptive control and inference
[AD-A194718] N88-29443
Linearized model matching for single-imput nonlinear systems
[AD-A193642] N88-29445
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r
[AD-A193510] N88-29506
LINEARITY
An integral equation for the linearized unsteady supersonic flow over a wing
[AD-A193773] N88-28887
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064
A linear-time algorithm for finding a minimum spanning pseudoforest
[AD-A194029] N88-29346
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise
[AD-A193865] N88-29492
LINKAGES
Skin friction balance
[NASA-CASE-LAR-13710-1] N88-29145
LIQUID CRYSTALS
Quasi-liquid crystalline materials with special electro-optic properties
[AD-A194579] N88-29544
Thermodynamical, optical and X-rays studies of some thermotropic liquid crystals
[DE88-702301] N88-29590
LIQUID FILLED SHELLS
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
LIQUID FUELS
Combustion studies of acoustically suspended liquid droplets
[AD-A193892] N88-28998
LIQUID HELIUM
An experimental setup for the study of polarized He3 and dilute He3-He4 mixtures
[B8705589] N88-29001
LIQUID METALS
Liquid metal thermal-electric converter electrode development
[DE88-009252] N88-29221
LIQUID PHASE EPITAXY
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600
LIQUID PHASES
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193881] N88-28997
LIQUIDS
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
Liquid thickness gauge
[NASA-CASE-LAR-13826-1] N88-29150
LISP (PROGRAMMING LANGUAGE)
The concurrent common Lisp development environment N88-29422
LITHIUM ALLOYS
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193768] N88-29011
LITHOSPHERE
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
LOADS (FORCES)
Estimation forces acting on an underwater vehicle with G.P.S. (Global Positioning System) and Kalman filtering
[AD-A194339] N88-28901
Plastic flow and failure modeling under high strain rate loading
[AD-A194223] N88-29199
LOCAL AREA NETWORKS
Intelligent resource management for local area networks: Approach and evolution N88-29385
LOCKS (FASTENERS)
Collet lock joint for space station truss
[NASA-CASE-MSC-21207-1] N88-29180
LOGIC CIRCUITS
Nanosequencer digital logic controller
[NASA-CASE-NPO-16118-2] N88-29310
LOGIC DESIGN
Knowledge elicitation for an operator assistant system in process control tasks N88-29366
LOGIC PROGRAMMING
Unification and set-valued functions for functional and logic programming
[AD-A193643] N88-29341
Practical higher-order functional and logic programming based on lambda-calculus and set-abstraction
[AD-A193845] N88-29486
LOGISTICS
Inflight rearming
[AD-A193564] N88-28909
LOGISTICS MANAGEMENT
Reliability and Maintainability (R and M)
[AD-A193857] N88-29187
LONG TERM EFFECTS
Long-term behavior of energy production systems with the example of HELIOS and SYMPHONIE
[ETN-88-92988] N88-29223
LONG WAVE RADIATION
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165
LONGITUDINAL CONTROL
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895
LONGITUDINAL STABILITY
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-28891
LOOPS
Polymeric heat pipe wick
[NASA-CASE-GSC-13019-1] N88-29133
LORENTZ FORCE
Difficulties with interpretation of underground muons from Cygnus X-3
[DE88-701645] N88-29710
LOSSES
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites
[UTIAS-324] N88-28970
Conductor loss in superconducting power transmission cables
[DE88-011414] N88-29586
LOW ALTITUDE
Low altitude: A new dimension in air refueling
[AD-A193819] N88-28910
LOW COST
Finding minimum-cost circulations by canceling negative cycles
[AD-A194027] N88-29468
Finding minimum-cost circulations by successive approximation
[AD-A194028] N88-29469
LOW GRAVITY MANUFACTURING
Optimization of low gravity materials processing experiments using expert systems N88-29361
LOW PASS FILTERS
Anti-aliasing filters for dynamics and control experiments
[AD-A193758] N88-29203
LOW REYNOLDS NUMBER
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
LOW SPEED WIND TUNNELS
Effects of independent variation of Mach and Reynolds numbers on the low-speed aerodynamic characteristics of the NACA 0012 airfoil section
[NASA-TM-4074] N88-28879
LOW TEMPERATURE
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92985] N88-29617
LUBRICANT TESTS
Characterization of lubricants in terms of transition diagram data
[AD-A194264] N88-29025
LUBRICANTS
Development of high temperature, high pressure rotating shaft seals
[DE88-001029] N88-29172
LUBRICATING OILS
Reaction-theoretical aspects of the thermal behavior of lubricating oils and working fluids
[NASA-TT-20304] N88-29041
LUNAR BASES
Space transportation nodes assumptions and requirements: Lunar base systems study task 2.1
[NASA-CR-172052] N88-28944

M

MACHINING
Surface properties in electric discharge machining
[NASA-TT-20243] N88-29182
MAGMA
What SNC meteorites tell us about Martian magmatism N88-29679
MAGNETIC DIPOLES
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624
MAGNETIC FIELDS
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551
High-T(sub c) superconductor and its use in superconducting magnets
[DE88-008403] N88-29581
Activity-rotation relations for lower main sequence stars N88-29640
Resonant spin-flavor precession of solar and supernova neutrinos
[DE88-752604] N88-29707
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29708
MAGNETIC MATERIALS
DARPA-URI consortium meetings on submicron heterostructures of diluted magnetic semiconductors
[AD-A193499] N88-29081
Mathematical theory and calculations of magnetic hysteresis curves
[DE88-011055] N88-29510
MAGNETIC MOMENTS
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624
MAGNETIC PROPERTIES
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
MAGNETIC SIGNALS
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
MAGNETOACOUSTIC WAVES
Method and apparatus for non-destructive testing of temper embrittlement in steels
[NASA-CASE-LAR-13817-1] N88-29012
MAGNETOCARDIOGRAPHY
Methods and instrumentation for biomagnetism
[AD-A193811] N88-29278
MAGNETOHYDRODYNAMIC STABILITY
Density fluctuations in currentless high beta plasmas in Heliotron E
[DE88-752310] N88-29550
A survey of the current experimental database for lower hybrid current-drive and heating
[DE88-009830] N88-29552
Numerical simulations of resistive magnetohydrodynamic instabilities in a poloidal divertor tokamak
[DE88-010768] N88-29559
MAGNETOHYDRODYNAMICS
Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments
[DE88-010202] N88-29329
The interaction of Io with the plasma torus N88-29704
MAGNETRON SPUTTERING
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583
MAIN SEQUENCE STARS
Activity-rotation relations for lower main sequence stars N88-29640
MAINTAINABILITY
Reliability and Maintainability (R and M)
[AD-A193857] N88-29187
MAINTENANCE
Maintenance of vision-related components N88-29296

MAN MACHINE SYSTEMS
General operational and training visual concerns N88-29295
Artificial intelligence applied to process signal analysis N88-29359

MAN-COMPUTER INTERFACE
Knowledge elicitation for an operator assistant system in process control tasks N88-29386
Intelligent interfaces for expert systems N88-29397
A space station onboard scheduling assistant N88-29402
Intelligent interface design and evaluation N88-29405

MANAGEMENT INFORMATION SYSTEMS
Reliability and Maintainability (R and M) [AD-A193657] N88-29187

MANAGEMENT METHODS
Advanced information processing system: Input/output network management software [NASA-CR-181678] N88-29431
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan [AD-A194357] N88-29495

MANEUVERS
Performance of GPS-aided INS during high-dynamic maneuvers [AD-A194624] N88-28903
The principles of mass and maneuver applied to space operations [AD-A194037] N88-29500

MANIPULATORS
Motion planning with obstacles and dynamic constraints N88-29175
Study on design and control of torque-controlled manipulators [NASA-TT-20197] N88-29183
Implementation of a flexible link model in a designed robot system, using the finite element method [ETN-88-92902] N88-29303
A robotic system for automation of logistics functions on the Space Station N88-29407
Next-generation space manipulator N88-29428

MANNED MANEUVERING UNITS
Personnel occupied woven envelope robot N88-29408

MANNED SPACE FLIGHT
Study of biological effects and radiation protection to future European manned space flights [DGT-33061] N88-29535

MANY BODY PROBLEM
Dynamics of interacting galaxies N88-29647

MAPPING
Monotone recurrence relations, their Birkhoff orbits and topological entropy [AD-A193481] N88-29504
Mapping of volcanic units at Alba Patera, Mars N88-29663
Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29666
Chemical and spectroscopic characterization of a suite of Mars soil analogs N88-29667
The Martian sedimentary record N88-29669
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
Geology of six possible Martian landing sites N88-29682
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683

MAPS
Distortion estimates for negative Schwarzian maps [AD-A193172] N88-29209
Polynomial definition of discrete field points of map of diffusion equation, part 1 [AD-A193697] N88-29487

MARINE METEOROLOGY
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987 [AD-A193960] N88-29251

MARKOV PROCESSES
Approximate evaluation of semi-Markov chain reliability models [AD-A194669] N88-29185
Dynamic analysis of computer and communications sytems: Semi-Markov approach N88-29305
Hidden Markov models for automatic speech recognition: Theory and application [RSRE-MEMO-4135] N88-29350
Approximations and implementations of nonlinear filtering schemes [AD-A194685] N88-29482
On stable Markov processes [AD-A192892] N88-29482

MARS (PLANET)
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658
An introduction to the historical records of China about Mars N88-29664
How dirty is Mars' North Polar cap, and why isn't it black N88-29677
Preliminary analysis of recent 2.2-4.2 micrometers telescopic observations of Elysium, Mars: Implications for crystallinity and hydration state of surface materials N88-29692
Mars earth-based radar: 1986 results and 1988-1990 opportunities N88-29697

MARS ATMOSPHERE
Chemical interactions between the present-day Martian atmosphere and surface minerals N88-29689

MARS SURFACE
MEVTV Workshop on Nature and Composition of Surface Units on Mars [NASA-CR-183075] N88-29654
Surface composition of Mars: A Viking multispectral view N88-29655
A review: Quantitative models for lava flows on Mars N88-29656
Mars: Spectral signatures seen and unseen N88-29659
Selective weathering of shocked minerals and chondritic enrichment of the Martian fines N88-29660
Intercrater plains deposits and the origin of Martian valleys N88-29661
Weathering of sulfides on Mars N88-29662
Elemental composition of the Martian surface N88-29665
Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29666
Chemical and spectroscopic characterization of a suite of Mars soil analogs N88-29667
The Martian sedimentary record N88-29669
Gamma-ray/neutron spectroscopy from the Mars observer N88-29671
Aqueous alteration in S-N-C meteorites and implications for weathering products on Mars N88-29673
Distribution and timing of thick transient air-fall deposits in Electris: Implications for the nature of the upland plains N88-29674
Photogeological inferences of Martian surface composition N88-29675
Some probable characteristics of the Martian regolith N88-29678
Surface units on Mars: The assemblage in the Valles Marineris N88-29680
Morphologic contrasts between Nirgal and Auqakuh Valles, Mars: Evidence of different crustal properties N88-29681
Geology of six possible Martian landing sites N88-29682
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684
Viking Landers and remote sensing N88-29685
Origin of northern lowland plains: Constraints from boundary morphology N88-29687
Episodic vs. epochal release of SO2 on Mars N88-29688
Chemical interactions between the present-day Martian atmosphere and surface minerals N88-29689
Stratigraphy of the Kasei Valles region, Mars N88-29690
Topography of large craters on Mars: Implications for the highlands resurfacing history N88-29691
Early cratering rates and the nature of the Martian cratered uplands N88-29694
Documenting volcano-tectonic episodes in Mars' stratigraphic record N88-29695
The surface composition of Mars from earthbased observations N88-29696
Crystal fractionation in the SNC meteorites: Implications for surface units on Mars N88-29698
Martian surface analogs: Laboratory spectral studies in the mid infrared N88-29699
Ridged and gullied terrains in the Martian uplands N88-29700
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701
Coadsorption of H2O and CO2 on the Martian surface N88-29702
High resolution Viking Orbiter images: A useful data source for testing the viability of geomorphic processes attributed to Martian landforms N88-29703

MARS VOLCANOES
MEVTV Workshop on Nature and Composition of Surface Units on Mars [NASA-CR-183075] N88-29654
The history of Martian volcanism determined from a revised relative chronology N88-29657
Weathering of sulfides on Mars N88-29662
Mapping of volcanic units at Alba Patera, Mars N88-29663
Small Martian volcanoes N88-29668
The Martian sedimentary record N88-29669
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
Variability in spectral signatures of terrestrial volcanic rocks and implications for volcanology on Mars N88-29672
What SNC meteorites tell us about Martian magmatism N88-29679
Volcano evolution on Mars N88-29686
Episodic vs. epochal release of SO2 on Mars N88-29688
Documenting volcano-tectonic episodes in Mars' stratigraphic record N88-29695

MARTENSITIC TRANSFORMATION
Kinetic of martensitic transformations induced by hydrogen in the austenite [DE88-701623] N88-29007

MASKS
Smoke hoods: Net safety benefit analysis --- aircraft accidents [CAA-PAPER-87017] N88-28898

MASS
The principles of mass and maneuver applied to space operations [AD-A194037] N88-29500

MATCHING
Cleanability of aircraft polyurethane topcoats [AD-A193456] N88-28878
On broadband matching of multiport electrical networks with applications [AD-A194224] N88-29086
Linearized model matching for single-imput nonlinear systems [AD-A193642] N88-29445

MATERIALS HANDLING
A robotic system for automation of logistics functions on the Space Station N88-29407

MATHEMATICAL MODELS
Development and analysis of turbulent non-equilibrium boundary layers N88-28872
Vortex flows N88-28875
Environmental effects on transition and boundary layer characteristics N88-28876
Contributions to the modeling of wind shear for danger studies [NASA-TT-20293] N88-28900
Structural dynamics of maneuvering aircraft [AD-A192378] N88-28908
Progress on a Monte Carlo shuttle contamination model [AD-A193694] N88-28945
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system [NASA-CR-178974] N88-28965
Phenomena of the ionic transport in the stress corrosion of metals [DE88-702502] N88-29013
Thin film-residual stress assessment [AD-A193205] N88-29018
Development of creep fracture modelling in ceramics [PB88-202825] N88-29021
Open bosonic string in background electromagnetic field [DE88-702140] N88-29053
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs [AD-A193462] N88-29080
Numerical investigations in three-dimensional internal flows [NASA-CR-183108] N88-29108
Stability control of leakage flow channels [DE88-009995] N88-29107
Modeling of large stall in axial compressors [VKI-NT-164] N88-29124
Modeling of momentum transport of axially parallel turbulent flows in rod cascades [ETN-88-92978] N88-29131
Solid-state laser research report: Energy transfer in non-uniform codoped crystals [AD-A194358] N88-29181
Modeling of pulsed gas flow lasers [ESA-TT-1090] N88-29189
Development of the Simplified Compressor Model (SCM) for performance analysis of gaseous diffusion compressors [DE88-009066] N88-29173

Approximate evaluation of semi-Markov chain reliability models
[AD-A194669] N88-29185
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191
Mechanics of thrust fault formation N88-29229
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
Analysis of the hopfield neural networks and their application to pattern recognition
[AD-A193827] N88-29279
Optimization-driven machine-oriented motion measurement N88-29312
Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments
[DE88-010202] N88-29329
Hidden Markov models for automatic speech recognition: Theory and application
[RSRE-MEMO-4135] N88-29350
AI and simulation: What can they learn from each other N88-29391
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432
Computer-Aided-Control Engineering (CACE) primitives for robust and adaptive control systems, phase 1
[AD-A192446] N88-29439
Easy Bayes estimation for Rasch-type models
[AD-A193628] N88-29491
Mathematical theory and calculations of magnetic hysteresis curves
[DE88-011055] N88-29510
Fusion product spectra
[DE88-010912] N88-29554
Electrical conductivity of GaAs layers implanted on semi-insulator nondoped substrates
[CERT-422000/RF] N88-29614
A review: Quantitative models for lava flows on Mars N88-29656
Origin of northern lowland plains: Constraints from boundary morphology N88-29687
Coadsorption of H2O and CO2 on the Martian surface N88-29702

MATHEMATICAL PROGRAMMING
Motion planning with obstacles and dynamic constraints N88-29175
Multicriteria integer programming for problems involving linear and nonlinear utility functions
[AD-A194530] N88-29336
Computer systems for the representation and manipulation of mathematical knowledge
[AD-A193547] N88-29340

MATRICES (MATHEMATICS)
On matrix pencil equivalents of a general polynomial matrix
[MATH-REPT-207] N88-29479
On Wiener-Masani's algorithm for finding the generating function of multivariate stochastic processes
[NASA-CR-182905] N88-29481
Invariant ideals of multiplicity free algebraic group actions
[B8803517] N88-29509

MATRIX MATERIALS
Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum hydroxide
[NASA-TT-20332] N88-29003

MAXIMUM LIKELIHOOD ESTIMATES
Easy Bayes estimation for Rasch-type models
[AD-A193628] N88-29491

MEASURING INSTRUMENTS
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28896
Skin friction balance
[NASA-CASE-LAR-13710-1] N88-29145
Ice detector
[NASA-CASE-LAR-13776-1] N88-29149
Liquid thickness gauge
[NASA-CASE-LAR-13826-1] N88-29150

MECHANICAL DEVICES
A technique for measuring area under a curve
[AD-A193559] N88-29463

MECHANICAL PROPERTIES
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
Relation between strength, creep and relaxation behavior in Cu and Al at room temperature
[ETN-88-92982] N88-29015
Thin film-residual stress assessment
[AD-A193205] N88-29018
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200

MECHANICAL SHOCK
Selective weathering of shocked minerals and chondritic enrichment of the Martian fines N88-29660

MEDICAL SCIENCE
The NBS/NRL (National Bureau of Standards/Naval Research Laboratory) free electron laser facility
[AD-A194214] N88-29159

MEDICAL SERVICES
Activities report in aerospace medicine
[ETN-88-92906] N88-29283

MELTING
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces
[DE88-004686] N88-29006

MEMBRANES
Method of forming dynamic membrane on stainless steel support
[NASA-CASE-MSC-18172-3] N88-29052
Hydrogen concentration cells as converters of heat into electricity
[DE88-009662] N88-29216

MEMORY
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151
Analysis of the hopfield neural networks and their application to pattern recognition
[AD-A193827] N88-29279
Transformations of short-term visual memory
[AD-A193873] N88-29290

MEMORY (COMPUTERS)
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432

MENTAL PERFORMANCE
Human performance and acute hypoxia, chapter 12
[AD-A192604] N88-29270
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288

MERCURY (METAL)
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600

MERCURY CADMIUM TELLURIDES
New method for preparation of (Cd, Hg)Te thin films
[DE88-702727] N88-29608

MERCURY TELLURIDES
Tunnelling currents in reverse biased CMT photodiodes
[RSRE-MEMO-4137] N88-29097

MESSAGE PROCESSING
Method for Veterbi decoding of large constraint length convolutional codes
[NASA-CASE-NPO-17310-1-CU] N88-28946
Coding for meteor-burst communications channel and side information for channels with block-interference N88-29054
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058
A performance study of the hypercube architecture
[AD-A194361] N88-29433

METAL FATIGUE
AGARD engine disc cooperative test programme
[AGARD-R-766] N88-28926

METAL FILMS
Optical emission from surface waves supported in thin metal films N88-29540
Temperature dependence of conductivity and of Hall coefficients for noble metal films
[ETN-88-92981] N88-29616

METAL FOILS
Hydrogen permeation through metallic foils
[DE88-702600] N88-29000

METAL HALIDES
Metal halide optical glasses
[AD-A193794] N88-29032

METAL HYDRIDES
Super hydrides
[AD-A193710] N88-28995

METAL MATRIX COMPOSITES
Investigation of a SiC/Ti-24Al-11Nb composite
[NASA-TM-100956] N88-28980
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005

METAL OXIDE SEMICONDUCTORS
Evaluation of silicon-on-insulator MOS (Metal-Oxide-Semiconductor) transistor response to 10-keV X-ray and cobalt-60 irradiation
[DE88-006102] N88-29082

METAL PLATES
High effectiveness contour matching contact heat exchanger
[NASA-CASE-MSC-20840-1] N88-29132

METAL STRIPS
Method for maintaining precise suction strip porosities
[NASA-CASE-LAR-13638-1] N88-29051

METAL SURFACES
Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni3Al
[DE88-702718] N88-29014

METAL-GAS SYSTEMS
Evaluation of a diffusion/trapping model for hydrogen ingress in high-strength alloys
[AD-A194301] N88-29008

METAL-METAL BONDING
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176

METALLICITY
Molecular hydrogen in galaxies N88-29645

METALLIZING
Laser and electrochemical studies of metallizations in electronic devices
[AD-A193786] N88-29090

METALS
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
Phenomena of the ionic transport in the stress corrosion of metals
[DE88-702502] N88-29013
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151
System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice
[DE88-702686] N88-29606

METASTABLE STATE
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29185

METEORITES
MEVTV Workshop on Nature and Composition of Surface Units on Mars
[NASA-CR-183075] N88-29654
Selective weathering of shocked minerals and chondritic enrichment of the Martian fines N88-29660
Aqueous alteration in S-N-C meteorites and implications for weathering products on Mars N88-29673
What SNC meteorites tell us about Martian magmatism N88-29679
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683
Origin of SNC kaersutitic amphibole: Experimental data N88-29693
Crystal fractionation in the SNC meteorites: Implications for surface units on Mars N88-29698

METEOROID HAZARDS
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-28959

METEOROLOGICAL PARAMETERS
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247

METEOROLOGY
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247

METHANE
Molecular composites processing and properties, 1
[AD-A194113] N88-28974
The design of methane activation catalysts
[DE88-002265] N88-29043
Ultraviolet absorption cross sections of chloro- and chlorofluoromethanes at stratospheric temperatures
[AERONOMICA-ACTA-A-324-1988] N88-29228

METHYL COMPOUNDS
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027

MICROBIOLOGY
Quality control in microbiology: CDC lab manual
[PB88-179890] N88-29263

MICROCOMPUTERS
Finite Element Composite Analysis Program (FECAP) for a microcomputer
[NASA-TM-100670] N88-28982
A computer program package for introductory one-dimensional digital signal processing applications
[AD-A194656] N88-29338

MICROCRACKS
Kinetic of martensitic transformations induced by hydrogen in the austenite
[DE88-701623] N88-29007
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193

MICROMETEOROIDS
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-29959

MICROPHONES
Noise levels from a jet-engined aircraft measured at ground level and at 1.2 m above the ground
[NPL-AC-114] N88-29524

MICROPROCESSORS
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194654] N88-29337

MICROSTRUCTURE
High temperature electric arc furnace
[NASA-CASE-MFS-26281-1] N88-28938
Ultrafine microstructure composites prepared by chemical vapor deposition
[AD-A193849] N88-28973
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
Effects of metal substitutions (Fe and Ga) in YBa2Cu3O7 on its superconducting properties and microstructures
[DE88-007393] N88-29572
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584

MICROTRONS
Analysis of free electron laser performance utilizing the National Bureau of Standards CW microtron
[AD-A194217] N88-29160

MICROWAVE AMPLIFIERS
Recent advances in high-power microwave amplifiers
[DE88-007820] N88-29063
Space-charge-wave solid state microwave amplifier
[AD-A193792] N88-29091

MICROWAVE EQUIPMENT
HPM (High-Power Microwave) coupling into realistic targets
[DE88-011788] N88-29084

MICROWAVE FILTERS
Band pass with cavity resonators by use of three oscillation types
[ETN-88-92984] N88-29096

MICROWAVE FREQUENCIES
Microwave frequency nondestructive control
[CERT-2/1355-MO] N88-28976
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113

MICROWAVES
Improvements in techniques of microwave thermography
[AD-A194613] N88-29062
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276

MIDAIR COLLISIONS
UK airmisses involving commercial air transport
[CAA-1/88] N88-28907

MILITARY OPERATIONS
Inflight rearming
[AD-A193564] N88-28909
Low altitude: A new dimension in air refueling
[AD-A193819] N88-28910
Defensive platform size and survivability
[DE88-011634] N88-28948
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177
SDI (Strategic Defense Initiative): A policy analysis
[AD-A194240] N88-29493
The problem of space in Soviet operational art
[AD-A194150] N88-29502

MILITARY SPACECRAFT
The principles of mass and maneuver applied to space operations
[AD-A194037] N88-29500
The problem of space in Soviet operational art
[AD-A194150] N88-29502

MILITARY TECHNOLOGY
Dynamically reconfigurable distributed database systems
[AD-A194716] N88-29636

MILKY WAY GALAXY
The kinematics of Milky Way halo gas N88-29648

MILLIMETER WAVES
Multi-sensory tracking mount control
[AD-A194675] N88-29339
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-182443] N88-29653

MINERALOGY
Volcano evolution on Mars N88-29686

MINERALS
Selective weathering of shocked minerals and chondritic enrichment of the Martian fines N88-29660

MINIMA
A linear-time algorithm for finding a minimum spanning pseudoforest
[AD-A194029] N88-29346
Faster algorithms for the shortest path problem
[AD-A194031] N88-29347

MINIMAX TECHNIQUE
A minimax method for a class of Hamiltonian systems with singular potentials
[AD-A193478] N88-29453

MIR SPACE STATION
The Soviet MIR space station
[AD-A194040] N88-28951

MIRRORS
Planarization of metal substrates for solar mirrors
[DE88-011492] N88-29214

MISSILE CONTROL
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194654] N88-29337

MISSILE SYSTEMS
Aircraft avionics and missile system installation cost study. Volume 1: Technical report and appendices A through E
[AD-A194605] N88-28923

MISSILES
Missiles, fuselage and similar bodies N88-28858
Missiles, fuselages and similar bodies N88-28869

MISSION PLANNING
Inflight rearming
[AD-A193564] N88-28909
Analyst-centered models for systems design, analysis, and development N88-29364
A plan for time-phased incorporation of automation and robotics on the US space station N88-29377
A scheduling and resource management system for space applications N88-29383
Two implementations of the Expert System for the Flight Analysis System (ESFAS) project N88-29400
Experiment scheduling for Spacelab missions N88-29404
Blackboard architectures and their relationship to autonomous space systems N88-29414

MIXING
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
Strong law for mixing sequence
[AD-A193615] N88-29490

MIXTURES
Blends of crystallizable polybutadienes
[AD-A194536] N88-29026

MOBILE COMMUNICATION SYSTEMS
Random-access algorithms for environments with capture
[AD-A194303] N88-29060

MODAL RESPONSE
Asymptotic modal analysis and statistical energy analysis
[NASA-CR-183077] N88-29514

MODELS
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2
[DE88-010416] N88-29248
Conjunctive measurement theory: Cognitive research prospects
[AD-A193627] N88-29277
A model of information growth N88-29440
Linearized model matching for single-input nonlinear systems
[AD-A193642] N88-29445
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
Can we calculate the fundamental dimensionless constants of physics
[DE88-702641] N88-29625

MODEMS
An OKQPSK modem incorporating numerically controlled carrier synthesis
[DE88-009536] N88-29304

MODULARITY
The SMITE modular compilation system
[RSRE-MEMO-4145] N88-29307

MODULATION
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064

MOIRE INTERFEROMETRY
J-integral measurement using moire interferometry
[AD-A193751] N88-29202

MOISTURE
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites
[UTIAS-324] N88-28970

MOISTURE CONTENT
On experiences with two hot-wire instruments for measuring the liquid water content in clouds
[ESA-TT-1085] N88-29255

MOLECULAR DIFFUSION
Molecular composites processing and properties, 1
[AD-A194113] N88-28974

MOLECULAR EXCITATION
Charge storage and switching phenomena in metal complexes
[AD-A193778] N88-28996
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141

MOLECULAR GASES
Molecular hydrogen in galaxies N88-29645

MOLECULAR SPECTROSCOPY
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141

MOLECULAR STRUCTURE
Raman spectroscopy on simple molecular systems at very high density
[DE88-010947] N88-28987
Hydrogen storage by molecular polyhydrides
[AD-A194207] N88-28989
Blends of crystallizable polybutadienes
[AD-A194536] N88-29026
Nonlinear optical processes in molecular systems
[AD-A193871] N88-29546
Localized excitations in one-dimensional molecular crystal with structural defect
[DE88-702691] N88-29607

MOMENTS
Moment invariants for particle beams
[DE88-011052] N88-29537

MOMENTUM TRANSFER
Modeling of momentum transport of axially parallel turbulent flows in rod cascades
[ETN-88-92978] N88-29131

MONATOMIC GASES
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168
Theoretical investigation of image states of the hydrogen covered Cu (100)
[DE88-702662] N88-29604

MONATOMIC MOLECULES
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168

MONOMERS
Charge storage and switching phenomena in metal complexes
[AD-A193778] N88-28996
Polymerization of azaethylenes (imines) and aza-1,3-dienes: Potential reactive monomers
[AD-A194717] N88-29028

MONOTONE FUNCTIONS
Periodic solutions of perturbed superquadratic Hamiltonian systems
[AD-A194292] N88-29457
Monotone recurrence relations, their Birkhoff orbits and topological entropy
[AD-A193481] N88-29504

MONTE CARLO METHOD
Progress on a Monte Carlo shuttle contamination model
[AD-A193694] N88-28945
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701

MORPHOLOGY
Mechanics of thrust fault formation N88-29229
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658

Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29666
Small Martian volcanoes N88-29668
Distribution and timing of thick transient air-fall deposits in Electris: Implications for the nature of the upland plains N88-29674
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684
Volcano evolution on Mars N88-29686
Origin of northern lowland plains: Constraints from boundary morphology N88-29687
Ridged and gullied terrains in the Martian uplands N88-29700

MOTION
Motion planning for legged locomotion systems on uneven terrain N88-29170
Motion planning with obstacles and dynamic constraints N88-29175
Passive damping concepts for free and forced member and grillage vibration
[NASA-CR-183114] N88-29196
Optimization-driven machine-oriented motion measurement N88-29312

MOTION PERCEPTION
Determining vehicle motion from stereo image sequences
[AD-A194371] N88-29140
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288

MOTION SIMULATION
Interactive, networked moving platform simulators
[AD-A192374] N88-28940

MOTION STABILITY
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110

MULTIPATH TRANSMISSION
Random-access algorithms for environments with capture
[AD-A194303] N88-29060

MULTIPLE ACCESS
The emergence of multi-user expert systems N88-29406

MULTIPLEXING
On broadband matching of multiport electrical networks with applications
[AD-A194224] N88-29086

MULTIPLICATION
Sequential approach to Colombeau's theory of generalized functions
[DE88-701869] N88-29503

MULTIPROCESSING (COMPUTERS)
Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments
[DE88-010202] N88-29329
The FORCE
[AD-A193463] N88-29429
Programming language concepts for multiprocessors
[AD-A193465] N88-29430
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432
Parallel real-time expert systems
[AD-A193673] N88-29434

MULTIVARIATE STATISTICAL ANALYSIS
An expert system for reliability modeling N88-29355
Robust control of multivariable and large scale systems
[AD-A194250] N88-29441

MUON SPIN ROTATION
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92985] N88-29617

MUONS
Difficulties with interpretation of underground muons from Cygnus X-3
[DE88-701645] N88-29710

N

NAP-OF-THE-EARTH NAVIGATION
Low altitude: A new dimension in air refueling
[AD-A193819] N88-28910

NASA PROGRAMS
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28928
Development and verification of NASA Standard Initiator-2 (NSI-2)
[NASA-CR-172069] N88-29044
Development and verification of NASA Standard Initiator-2 (NSI-2): Appendix
[NASA-CR-172070] N88-29045

NASTRAN
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204

NATIONAL AEROSPACE PLANE PROGRAM
Numerical investigations in three-dimensional internal flows
[NASA-CR-183108] N88-29106

NATURAL GAS
Absorption heat pumps
[DE88-752820] N88-29218

NATURAL LANGUAGE (COMPUTERS)
An expert system for natural language processing N88-29426

NAVIER-STOKES EQUATION
Steady and unsteady internal flow computations via the solution of the compressible Navier Stokes equations for low Mach numbers N88-29100
Three-dimensional laser Doppler velocimeter studies of flow in a 90 deg curved duct having a square cross-section N88-29101
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method
[AD-A193479] N88-29104
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-180484] N88-29116
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
Lessons learned in the mesh generation for PN/S calculations N88-29314
Mesh generation for industrial application of Euler and Navier Stokes solvers N88-29323
Experience with three dimensional composite grids N88-29324

NAVY
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS)
[NASA-CR-175104] N88-28917
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation
[AD-A193958] N88-29068

NEODYMIUM
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599

NEODYMIUM LASERS
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579

NETWORK ANALYSIS
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis
[AD-A192399] N88-29208
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539

NEUMANN PROBLEM
On a class of functionals invariant under a Z(sup n) action
[AD-A193474] N88-29451

NEURAL NETS
Analysis of the hopfield neural networks and their application to pattern recognition
[AD-A193827] N88-29279
Design of a feeling-thinking machine
[AD-A194107] N88-29448

NEUTRINOS
Neutrino detection primer
[AD-A193805] N88-29529
On neutrino fields in Einstein-Cartan theory
[MATH-REPT-208] N88-29629

NEUTRON SPECTROMETERS
Gamma-ray/neutron spectroscopy from the Mars observer N88-29671

NEWTON METHODS
Optimisation algorithms for highly parallel computer architectures. The performance of the truncated Newton, conjugate gradient algorithm in FORTRAN and Ada
[AD-A193940] N88-29435
Generating semi-Gaussian two dimensional quadrature rules
[REPT-205] N88-29476

NICKEL ALLOYS
Development of Nb-Ti multifilamentar superconducting wires
[DE88-702324] N88-29592

NIGHT SKY
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194246] N88-29237

NIGHT VISION
Night lighting and night vision goggle compatibility N88-29297

NIOBIUM
Investigation of a SiC/Ti-24Al-11Nb composite
[NASA-TM-100956] N88-28980

NIOBIUM ALLOYS
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584

NITRATES
Atmospheric deposition of nitrate to the ocean surface N88-29227

NITRO COMPOUNDS
Theoretical investigations of nitrocubane decomposition
[AD-A194556] N88-29047

NITROGEN FLUORIDES
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow
[AD-A194493] N88-29163

NOBLE METALS
Temperature dependence of conductivity and of Hall coefficients for noble metal films
[ETN-88-92981] N88-29616

NOISE (SOUND)
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
An investigation of acoustic cavitation produced by pulsed ultrasound
[AD-A193523] N88-29516

NOISE GENERATORS
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883

NOISE MEASUREMENT
Minimizing escape probabilities: A large deviations approach
[AD-A194534] N88-29496
Noise levels from a jet-engined aircraft measured at ground level and at 1.2 m above the ground
[NPL-AC-114] N88-29524

NOISE PREDICTION (AIRCRAFT)
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523

NOISE PROPAGATION
Investigation of helicopter rotor blade/wake interactive impulsive noise
[NASA-CR-177435] N88-28882

NOISE REDUCTION
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523

NOISE SPECTRA
High performance charge transfer device detectors
[AD-A194409] N88-28993

NONDESTRUCTIVE TESTS
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
Nondestructive tests and high performance composite structures
[SNIAS-881-430-119] N88-28969
Microwave frequency nondestructive control
[CERT-2/1355-MO] N88-28976
Contribution to the study of materials behavior in space environment
[SNIAS-881-430-104] N88-28977
Method and apparatus for non-destructive testing of temper embrittlement in steels
[NASA-CASE-LAR-13817-1] N88-29012
Radioactivity as a means of nondestructive testing
[DE88-702776] N88-29188
Nondestructive investigations for space use
[SNIAS-881-430-105] N88-29189
A generic expert system for materials processing in space N88-29376

NONEQUILIBRIUM FLOW
Development and analysis of turbulent non-equilibrium boundary layers N88-28872
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120

Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547

NONLINEAR EQUATIONS
The construction of implicit and explicit solitary wave solutions of nonlinear partial differential equations
[AD-A193475] N88-29452
MACSYMA program for the painleve test of nonlinear ordinary and partial differential equations
[AD-A194293] N88-29458
On nonlinear equations admitting soliton solutions with a deBroglie phase
[DE88-702694] N88-29508

NONLINEAR FEEDBACK
Robust control of multivariable and large scale systems
[AD-A194250] N88-29441
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r
[AD-A193510] N88-29506

NONLINEAR FILTERS
A nonlinear filtering process diagnostic system for the Space Station N88-29417
Approximations and implementations of nonlinear filtering schemes
[AD-A194685] N88-29462

NONLINEAR OPTICS
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration
[AD-A193825] N88-29164
Nonlinear optical processes in molecular systems
[AD-A193871] N88-29546

NONLINEAR SYSTEMS
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191
Linearized model matching for single-input nonlinear systems
[AD-A193642] N88-29445
Approximations and implementations of nonlinear filtering schemes
[AD-A194685] N88-29462
Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179686] N88-29480
Limiting distributions of non-linear vector functions of stationary Gaussian processes
[AD-A194569] N88-29488
Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547
Nonlinear analysis of non-neutral plasmas
[AD-A192506] N88-29556
The construction of the thermoelasticity equations on the basis of contemporary notions of nonlinear continua mechanics
[NASA-TT-20307] N88-29631
Resonance excitation of linear and non-linear spiral density waves in a gaseous disk N88-29643

NONLINEARITY
A singular perturbation analysis of the weakly nonlinear evolution of long and short water waves and waves in boundary layers N88-29102
Nonlinear vibrations of imperfect thin walled cylindrical shells
[ETN-88-92904] N88-29205
On the periodic nonlinearity and the multiplicity of solutions
[AD-A194295] N88-29459
Investigation of non-classical effects in two-photon interference processes N88-29541
Non-linear scale invariance in a cold-dark-matter universe
[DE88-011725] N88-29644

NONPARAMETRIC STATISTICS
A nonparametric multidimensional IRT approach with applications to ability estimation and test bias
[AD-A194212] N88-29483

NORMAL DENSITY FUNCTIONS
Weak solution of the Langevin equation on a generalized functional space
[AD-A194290] N88-29456

NORMALIZING (STATISTICS)
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r
[AD-A193510] N88-29506

NOTCH STRENGTH
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-29068

NOZZLE DESIGN
Numerical investigations in three-dimensional internal flows
[NASA-CR-183108] N88-29106

NOZZLES
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 1
[NASA-CR-178973] N88-28964

NUCLEAR FISSION
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570

NUCLEAR FUSION
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570

NUCLEAR MAGNETIC RESONANCE
Sol-gel kinetics: Si(sup)29 NMR and a statistical reaction model
[DE88-011545] N88-28988
Static and dynamic behavior of a quasi one-dimensional Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a He3-He4 dilution refrigerator
[B8705564] N88-29533

NUCLEAR PARTICLES
Large area nuclear particle detectors using ET materials
[NASA-CR-180777] N88-29136

NUCLEAR POWER PLANTS
Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants
[DE88-701621] N88-29174

NUCLEAR REACTIONS
Measure of hydrogen concentration profile in materials by resonant nuclear reactions
[DE88-702599] N88-28999
Hadrons produced in atmospheric interactions
[DE88-702492] N88-29712

NUCLEAR STRUCTURE
Nuclear magnetic ordering and paramagnetic relaxation of diatomic molecules in Ca (OH)2
[B8681489] N88-29532
Fluctuation and relaxation phenomena studied by means of nuclear orientation
[B8679671] N88-29534

NUCLEAR WARFARE
SDI (Strategic Defense Initiative). Where do we go from here
[AD-A194544] N88-29497

NULL ZONES
Polynomials with restricted coefficients and their applications
[AD-A192589] N88-29055

NUMERICAL ANALYSIS
A numerical study of the test time in a hypersonic shock tunnel
[AD-A194057] N88-28888
Random-access algorithms for environments with capture
[AD-A194303] N88-29060
Stability and drag reduction in a boundary layer with microbubbles
[AD-A191975] N88-29099
Steady and unsteady internal flow computations via the solution of the compressible Navier Stokes equations for low Mach numbers N88-29100
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193991] N88-29119
Thickness effects on the stability of shell like structures N88-29192
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise
[AD-A193865] N88-29492
Numerical simulations of resistive magnetohydrodynamic instabilities in a poloidal divertor tokamak
[DE88-010768] N88-29559

NUMERICAL STABILITY
Stability and convergence in the numerical solution of stiff initial value problems
[B8681480] N88-29474
On stable Markov processes
[AD-A192892] N88-29482

NUTRITIONAL REQUIREMENTS
Nutrient requirements for high stress environments
[AD-A194595] N88-29301

O

OCEAN BOTTOM
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518

OCEAN SURFACE
Atmospheric deposition of nitrate to the ocean surface N88-29227

ODD-ODD NUCLEI
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570

OILS
Study of experimental technique of oil flow with emphasis on quantitative determination of the flow position parameters on the surface
[NASA-TT-20341] N88-29135

OMEGA NAVIGATION SYSTEM
Indian Ocean validation
[AD-A194458] N88-28902

ONBOARD DATA PROCESSING
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Investigation of the use of High Order Languages (HOLs) for on-board software
[CRI/FR/HOL-C/1/87] N88-29349
An expert systems application to space base data processing N88-29384

ONBOARD EQUIPMENT
Generic supervisor: A knowledge-based tool for control of space station on-board systems N88-29389
A space station onboard scheduling assistant N88-29402

OPERATING COSTS
A contribution to the quantitative analysis of the influence of design parameters on the optimal design of passenger aircraft
[ETN-88-92979] N88-28912

OPERATING SYSTEMS (COMPUTERS)
Process migration in UNIX environments
[NASA-CR-182951] N88-29311

OPERATIONS RESEARCH
A fast parametric maximum flow algorithm, revision
[AD-A194026] N88-29345
Faster scaling algorithms for network problems
[AD-A194032] N88-29348
Finding minimum-cost circulations by canceling negative cycles
[AD-A194027] N88-29468
Finding minimum-cost circulations by successive approximation
[AD-A194028] N88-29469
Improved time bounds for the maximum flow problem
[AD-A194034] N88-29471

OPERATOR PERFORMANCE
Display system image quality N88-29298

OPTICAL BISTABILITY
Cooperative effects and intrinsic optical bistability in collections of atoms
[AD-A193993] N88-29530

OPTICAL COUNTERMEASURES
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166

OPTICAL EQUIPMENT
Beam optics test stand
[AD-A193901] N88-29144
Center for opto-electronic systems research instrumentation grant
[AD-A193711] N88-29545

OPTICAL MEASUREMENT
Metal halide optical glasses
[AD-A193794] N88-29032
Optical measurement of unducted fan blade deflections
[NASA-TM-100966] N88-29142

OPTICAL MEASURING INSTRUMENTS
Investigations on periodically perturbed optical waveguides
[B8712725] N88-29548

OPTICAL PROPERTIES
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28896
Optical emission behavior and radiation resistance of epoxy resins
[DE88-752629] N88-29023
Metal halide optical glasses
[AD-A193794] N88-29032
LLE (Laboratory for Laser Energetics) review
[DE88-008065] N88-29158

Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165
Planarization of metal substrates for solar mirrors
[DE88-011492] N88-29214
Vision through aircraft transparencies N88-29294
Quasi-liquid crystalline materials with special electro-optic properties
[AD-A194579] N88-29544
Nonlinear optical processes in molecular systems
[AD-A193871] N88-29546

OPTICAL RADAR
Program to increase the measurement capabilities of the AFGL (Air Force Geophysics Laboratory) fixed and mobile high altitude lidar systems
[AD-A194614] N88-29063
Large aperture multi-dimensional laser radar testbed
[AD-A193447] N88-29155
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987
[NASA-RP-1209] N88-29234

OPTICAL WAVEGUIDES
Investigations on periodically perturbed optical waveguides
[B8712725] N88-29548

OPTIMAL CONTROL
Motion planning with obstacles and dynamic constraints N88-29175
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191
Convex duality approach to the optimal control or diffusions
[AD-A194535] N88-29442

OPTIMIZATION
A contribution to the quantitative analysis of the influence of design parameters on the optimal design of passenger aircraft
[ETN-88-92979] N88-28912
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994
Free electron lasers with small period wigglers
[DE88-011627] N88-29156
Optimization-driven machine-oriented motion measurement N88-29312
Faster scaling algorithms for network problems
[AD-A194032] N88-29348
Optimization of low gravity materials processing experiments using expert systems N88-29361
Design consideration in constructing high performance embedded Knowledge-Based Systems (KBS) N88-29415
Optimisation algorithms for highly parallel computer architectures. The performance of the truncated Newton, conjugate gradient algorithm in FORTRAN and Ada
[AD-A193940] N88-29435

ORBITAL LAUNCHING
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194625] N88-28941

ORBITAL MANEUVERING VEHICLES
OMV docking simulator N88-29379

ORBITAL MANEUVERS
Study of Plasma Motor Generator (PMG) tether system for orbit reboost
[NASA-CR-172074] N88-28949
Machine vision for real time orbital operations N88-29367
Automated generation of spacecraft activity plans N88-29396

ORBITAL MECHANICS
Study of Plasma Motor Generator (PMG) tether system for orbit reboost
[NASA-CR-172074] N88-28949

ORBITAL RENDEZVOUS
Space transportation nodes assumptions and requirements: Lunar base systems study task 2.1
[NASA-CR-172052] N88-28944

ORBITAL SERVICING
Ariane 5, HERMES and European vehicles for space station servicing
[SNIAS-881-422-102] N88-28943
Remote servicing of space systems N88-29409
A teleoperated robotic manipulator system for materials processing experiment servicing N88-29410

ORBITS
A limiting viscosity approach to the Riemann problem for materials exhibiting change of phase
[AD-A193477] N88-29103
Monotone recurrence relations, their Birkhoff orbits and topological entropy
[AD-A193481] N88-29504

ORGANIC CHEMISTRY
Super hydrides
[AD-A193710] N88-28995

ORGANIC COMPOUNDS
Electron impact ionization cross-section of some organic compounds
[DE88-702044] N88-29525
Band electronic structures and crystal packing forces
[DE88-010247] N88-29585

ORGANIC MATERIALS
Hydrogen storage by molecular polyhydrides
[AD-A194207] N88-28989
Transport of organic vapors in multiphase polymer system
[AD-A194097] N88-29033

ORGANIC SILICON COMPOUNDS
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040

ORGANOMETALLIC COMPOUNDS
Metal grid base heterojunction transistor operating at 60 and 94 GHz
[AD-A194763] N88-29087

OSCILLATIONS
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895

OSCILLATOR STRENGTHS
On selection rules and inelastic electron scattering at intermediate energies
[DE88-701833] N88-29526

OSCILLATORS
Distortions in processed signals and their application in electronic design. Part 2: A new variable signal generator
[DE88-702732] N88-29071
An OKQPSK modem incorporating numerically controlled carrier synthesis
[DE88-009536] N88-29304

OUTPUT
Linearized model matching for single-input nonlinear systems
[AD-A193642] N88-29445

OXIDATION
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042
Preparation and testing of Nb-Zr and Nb-ZrO2 single crystals for deformation studies
[DE88-702798] N88-29613

OXIDATION-REDUCTION REACTIONS
High power storage system based on thin film solid ionics
[AD-A193823] N88-29598

OXIDE FILMS
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

OXIDES
Development of planar geometry solid oxide fuel cell technology, phase 1
[PB88-210356] N88-29215

OXYGEN
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168

OXYGEN BREATHING
Human performance and acute hypoxia, chapter 12
[AD-A192604] N88-29270

OXYGEN CONSUMPTION
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272
Effect of hypoxia on speech recognition in noise
[AD-A193943] N88-29280

OXYGEN IONS
Polymeric electrolytes
[AD-A193786] N88-29031
La2CuO(sub 4 + delta): A superconducting superoxide
[DE88-010325] N88-29578

OXYGEN MASKS
Miniature respiratory sensor
[AD-A193430] N88-29300

OZONE
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3
[AD-A194670] N88-29239
European validation of SAGE-2 aerosol profiles
[AERONOMICA-ACTA-A-327-1988] N88-29243

OZONE DEPLETION
Present state of knowledge of the upper atmosphere 1988: An assessment report
[NASA-RP-1208] N88-29233

P

PACKAGING
Procedures for identification and handling of Printed Circuit Boards (PCBs)
[AD-A191177] N88-29078

PAINTS
Cleanability of aircraft polyurethane topcoats
[AD-A193456] N88-28878

PAIR PRODUCTION
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570

PAPER (MATERIAL)
Absorption heat pumps
[DE88-752820] N88-29218

PARABOLAS
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems
[AD-A193560] N88-29484
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193896] N88-29517

PARABOLIC DIFFERENTIAL EQUATIONS
Lessons learned in the mesh generation for PN/S calculations N88-29314

PARALLEL COMPUTERS
Optimisation algorithms for highly parallel computer architectures. The performance of the truncated Newton, conjugate gradient algorithm in FORTRAN and Ada
[AD-A193940] N88-29435

PARALLEL PROCESSING (COMPUTERS)
Parallel real-time expert systems
[AD-A193673] N88-29434
Adaptive identification by systolic arrays
[AD-A193532] N88-29444

PARALLEL PROGRAMMING
The FORCE
[AD-A193463] N88-29429

PARAMAGNETISM
Nuclear magnetic ordering and paramagnetic relaxation of diatomic molecules in Ca (OH)2
[B8681469] N88-29532

PARAMETER IDENTIFICATION
Estimation of aircraft parameters using filter error methods and extended Kalman filter
[DFVLR-FB-88-15] N88-28911
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437

PARAMETERIZATION
Boundary layer manipulation N88-28877
Human auditory and visual continuous evoked potentials N88-29269
A fast parametric maximum flow algorithm, revision
[AD-A194026] N88-29345
Properties of strong coupled superconductors
[DE88-702050] N88-29574

PARTIAL DIFFERENTIAL EQUATIONS
The construction of implicit and explicit solitary wave solutions of nonlinear partial differential equations
[AD-A193475] N88-29452
MACSYMA program for the painleve test of nonlinear ordinary and partial differential equations
[AD-A194293] N88-29458

PARTICLE BEAMS
Beam optics test stand
[AD-A193901] N88-29144
Moment invariants for particle beams
[DE88-011052] N88-29537
Nonlinear analysis of non-neutral plasmas
[AD-A192506] N88-29556

PARTICLE INTERACTIONS
Study of superconducting properties in some many valley semiconductors
[DE88-702325] N88-29593

PARTICLE MOTION
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152

PARTICLE PRODUCTION
Hadrons produced in atmospheric interactions
[DE88-702492] N88-29712

PARTICLE SIZE DISTRIBUTION
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138

PARTICLE TRACKS
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152

PARTICLES
Theoretical and experimental investigations on the structure of stationary shock waves in gas particle dispersions
[ETN-88-92983] N88-29122
Theoretical particle physics
[DE88-011499] N88-29621
PASSENGER AIRCRAFT
A contribution to the quantitative analysis of the influence of design parameters on the optimal design of passenger aircraft
[ETN-88-92979] N88-28912
PATENT POLICY
Argonne National Laboratory technology transfer report, FY87
[DE88-010091] N88-29639
PATTERN RECOGNITION
Determining vehicle motion from stereo image sequences
[AD-A194371] N88-29140
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis
[AD-A192399] N88-29208
Limits of pattern discrimination in human vision
[AD-A193449] N88-29273
Analysis of the hopfield neural networks and their application to pattern recognition
[AD-A193827] N88-29279
Automatic object recognition N88-29368
Two dimensional convolute integers for machine vision and image recognition N88-29369
A generic expert system for materials processing in space N88-29376
PENETRATION
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
PERFORMANCE PREDICTION
High-aspect-ratio wings N88-28859
PERFORMANCE TESTS
Reliability assessment of Surface Mount Technology (SMT)
[AD-A193759] N88-29089
Construction of a laser Doppler anemometer and its use for the testing of a novel probe for the measurement of the variations of the lateral component of the vortex vector
[MPIS-13/1987] N88-29147
Two phase flow in a rotating screw tube (screw tube pump). Investigation of the function and efficiency of the screw tube pump
[MPIS-16/1987] N88-29178
Effects of precipitation on wind turbine performance
[DE88-001144] N88-29211
Systolic array fault tolerance performance analysis
[AD-A193521] N88-29308
A performance study of the hypercube architecture
[AD-A194361] N88-29433
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29446
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation
[AD-A193745] N88-29499
PERIGEES
Study of a safe attitude for the Infrared Space Observatory (ISO) during perigee pass
[SNIAS-881-440-113] N88-28954
PERIHELIONS
Mars earth-based radar: 1986 results and 1988-1990 opportunities N88-29697
PERIODIC FUNCTIONS
On a class of functionals invariant under a Z(sup n) action
[AD-A193474] N88-29451
Periodic solutions of perturbed superquadratic Hamiltonian systems
[AD-A194292] N88-29457
On the periodic nonlinearity and the multiplicity of solutions
[AD-A194295] N88-29459
PERIODIC VARIATIONS
Time periodic control of a multi-blade helicopter
[AD-A194435] N88-28931
PERMEATING
Hydrogen permeation through metallic foils
[DE88-702600] N88-29000
PERMITTIVITY
Viking Landers and remote sensing N88-29685
PEROXIDES
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042
PERSONAL COMPUTERS
Waveform analysis on the IBM PC
[AD-A194249] N88-29330
PERSONNEL
Flight information publication (FLIP) feedback
[AD-A194462] N88-28897
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed
[AD-A193779] N88-29289
PERSONNEL SELECTION
Proposed improvements to the USAF flight screening program
[AD-A194506] N88-29285
Validity of the academic aptitude composite of the Air Force Officer Qualifying Test (AFOQT)
[AD-A194753] N88-29286
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287
PERTURBATION
A singular perturbation analysis of the weakly nonlinear evolution of long and short water waves and waves in boundary layers N88-29102
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method
[AD-A193479] N88-29104
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
Periodic solutions of perturbed superquadratic Hamiltonian systems
[AD-A194292] N88-29457
Chaotic behaviour in quantum dynamics
[AD-A193936] N88-29623
PERTURBATION THEORY
Unfoldings of quasi-periodic tori
[B8811118] N88-29513
On the meaning of perturbation expansions in quantum field theory
[DE88-702138] N88-29620
PETROLOGY
Aqueous alteration in S-N-C meteorites and implications for weathering products on Mars N88-29673
PHASE CHANGE MATERIALS
Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547
PHASE COHERENCE
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
Cooperative effects and intrinsic optical bistability in collections of atoms
[AD-A193993] N88-29530
PHASE CONJUGATION
Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547
PHASE DEMODULATORS
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
PHASE DIAGRAMS
Raman spectroscopy on simple molecular systems at very high density
[DE88-010947] N88-28987
PHASE ERROR
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061
PHASE LOCKED SYSTEMS
Digital phase-lock loop having an estimator and predictor of error
[NASA-CASE-NPO-17196-1-CU] N88-29076
Human auditory and visual continuous evoked potentials N88-29269
PHASE SHIFT
Experimental investigations for the generation of phase modes for adaptive antennas
[REPT-10-87] N88-29074
PHASE SHIFT KEYING
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
PHASE TRANSFORMATIONS
Band electronic structures and crystal packing forces
[DE88-010247] N88-29585
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR
[DE88-752611] N88-29588
Thermodynamical, optical and X-rays studies of some thermotropic liquid crystals
[DE88-702301] N88-29590
PHASED ARRAYS
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066
PHOTOCHEMICAL REACTIONS
Chemical interactions between the present-day Martian atmosphere and surface minerals N88-29689
PHOTOCHROMISM
Quasi-liquid crystalline materials with special electro-optic properties
[AD-A194579] N88-29544
PHOTODIODES
Tunnelling currents in reverse biased CMT photodiodes
[RSRE-MEMO-4137] N88-29097
PHOTOGEOLOGY
MEVTV Workshop on Nature and Composition of Surface Units on Mars
[NASA-CR-183075] N88-29654
Surface composition of Mars: A Viking multispectral view N88-29655
Mapping of volcanic units at Alba Patera, Mars N88-29663
Small Martian volcanoes N88-29668
Photogeological inferences of Martian surface composition N88-29675
PHOTOGRAPHS
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137
PHOTOINTERPRETATION
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
High resolution Viking Orbiter images: A useful data source for testing the viability of geomorphic processes attributed to Martian landforms N88-29703
PHOTOLUMINESCENCE
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques
[DE88-008580] N88-29582
PHOTONS
Investigation of non-classical effects in two-photon interference processes N88-29541
PHOTORECEPTORS
Limits of pattern discrimination in human vision
[AD-A193449] N88-29273
PHOTOSPHERE
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29708
PHOTOSYNTHESIS
Electrochemical and optical studies of model photosynthetic systems
[DE88-009291] N88-29264
PHOTOVOLTAIC CELLS
SERI's photovoltaic research project: A foundation for tomorrow's utility-scale electricity
[DE88-001161] N88-29220
Solar dynamic power systems
[ETN-88-92969] N88-29224
PHYSICAL CHEMISTRY
Dry adhesive friction of elastomers: A study of the fundamental mechanical aspects
[ETN-88-92903] N88-29036
PHYSIOLOGICAL EFFECTS
USAF hyperbaric animal transfer chamber system
[AD-A193633] N88-29265
Effect of hypoxia on speech recognition in noise
[AD-A193943] N88-29280
Nutrient requirements for high stress environments
[AD-A194595] N88-29301
PHYSIOLOGICAL RESPONSES
Hierarchical structure in polymeric solids and its influence on properties
[AD-A194720] N88-29029
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266
PHYSIOLOGICAL TESTS
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287
PHYSIOLOGY
Vision and visual protection in fast jet aircraft N88-29292

PILOT PERFORMANCE
Proposed improvements to the USAF flight screening program
[AD-A194506] N88-29285
Visual Effects in the High Performance Aircraft Cockpit
[AGARD-LS-156] N88-29291
Vision and visual protection in fast jet aircraft N88-29292
Visual related accidents/incidents N88-29293
PILOT TRAINING
Flight information publication (FLIP) feedback
[AD-A194462] N88-28897
Future air-to-air training for the RF-4
[AD-A194363] N88-29284
General operational and training visual concerns N88-29295
PIPE FLOW
Rotation symmetric inside flow with diametric expansion resolution
[ILR-MITT-193] N88-29123
PIPELINING (COMPUTERS)
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432
PIPES (TUBES)
Passive damping concepts for free and forced member and grillage vibration
[NASA-CR-183114] N88-29196
Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels
[DE88-701619] N88-29198
PISTONS
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176
PITCH (INCLINATION)
Time periodic control of a multi-blade helicopter
[AD-A194435] N88-28931
PLAINS
Intercrater plains deposits and the origin of Martian valleys N88-29661
Distribution and timing of thick transient air-fall deposits in Electris: Implications for the nature of the upland plains N88-29674
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684
Origin of northern lowland plains: Constraints from boundary morphology N88-29687
Early cratering rates and the nature of the Martian cratered uplands N88-29694
PLANAR STRUCTURES
Development of planar geometry solid oxide fuel cell technology, phase 1
[PB88-210356] N88-29215
PLANE WAVES
On the degenerate Ferrari-Ibanez solution for colliding plane gravitational waves
[MATH-REPT-209] N88-29630
PLANETARY CRUSTS
Morphologic contrasts between Nirgal and Auqakuh Valles, Mars: Evidence of different crustal properties N88-29681
Stratigraphy of the Kasei Valles region, Mars N88-29690
PLANETARY EVOLUTION
Mars: Spectral signatures seen and unseen N88-29659
PLANETARY WAVES
Interactions between synoptic and planetary scales of motion
[AD-A192328] N88-29246
PLANNING
Motion planning for legged locomotion systems on uneven terrain N88-29170
Motion planning with obstacles and dynamic constraints N88-29175
PLASMA CONTROL
A survey of the current experimental database for lower hybrid current-drive and heating
[DE88-009830] N88-29552
Vortex formation and particle transport in a cross-field plasma sheath
[DE88-008931] N88-29553
PLASMA CURRENTS
The interaction of Io with the plasma torus N88-29704
PLASMA DENSITY
Density fluctuations in currentless high beta plasmas in Heliotron E
[DE88-752310] N88-29550
PLASMA DIAGNOSTICS
Introduction to laser plasma diagnostics
[DE88-011056] N88-29560
Apparatus for submillimeter laser diagnostics of high-temperature plasma
[DE88-702464] N88-29563
PLASMA DRIFT
Plasma theory and simulation
[AD-A194674] N88-29565
PLASMA DYNAMICS
Plasma theory and simulation
[AD-A194674] N88-29565
PLASMA EQUILIBRIUM
Vortex formation and particle transport in a cross-field plasma sheath
[DE88-008931] N88-29553
Plasmoid propagation
[AD-A192378] N88-29555
PLASMA GENERATORS
Study of Plasma Motor Generator (PMG) tether system for orbit reboost
[NASA-CR-172074] N88-28949
PLASMA HEATING
Initial operation and edge plasma studies in ATF (Advanced Toroidal Facility)
[DE88-011400] N88-29562
Apparatus for submillimeter laser diagnostics of high-temperature plasma
[DE88-702464] N88-29563
PLASMA INTERACTIONS
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
Tokamak plasma interaction with limiters
[UTIAS-325] N88-29566
PLASMA JETS
A study of mechanisms producing astrophysical jets
[AD-A194100] N88-29649
PLASMA PHYSICS
Plasma theory and simulation
[AD-A194674] N88-29565
PLASMA SHEATHS
Vortex formation and particle transport in a cross-field plasma sheath
[DE88-008931] N88-29553
Plasma theory and simulation
[AD-A194674] N88-29565
PLASMA TORCHES
Plasma torch design codes package
[SNIAS-881-430-115] N88-29569
PLASMA WAVES
Plasmoid propagation
[AD-A192378] N88-29555
PLASMAS (PHYSICS)
Effect of a laser field in the electron inelastic scattering into plasma fields
[DE88-702295] N88-29157
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551
Fusion product spectra
[DE88-010912] N88-29554
Nonlinear analysis of non-neutral plasmas
[AD-A192506] N88-29556
Bootstrap currents in radio-frequency-driven tokamak equilibria
[DE88-011136] N88-29561
Collector and source sheaths of a finite ion temperature plasma
[DE88-008934] N88-29564
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706
PLASMONS
Optical emission from surface waves supported in thin metal films N88-29540
System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice
[DE88-702686] N88-29606
PLASTIC COATINGS
Cleanability of aircraft polyurethane topcoats
[AD-A193456] N88-28878
PLASTIC DEFORMATION
Results on the influence of crack tip plasticity during dynamic crack growth
[AD-A193460] N88-29194
PLASTIC FLOW
Plastic flow and failure modeling under high strain rate loading
[AD-A194223] N88-29199
PLATE THEORY
Improved finite strip Mindlin plate bending element using assumed shear strain distributions
[NASA-TM-100928] N88-29195
PLATES (TECTONICS)
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
PLOTTING
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204
A computer program package for introductory one-dimensional digital signal processing applications
[AD-A194656] N88-29338
POINTS (MATHEMATICS)
An algorithm for determining the location of points in computer simulations
[AD-A193713] N88-29343
POISSON EQUATION
An asymptotic evaluation of the tail of a multiple symmetric alpha-stable integral
[AD-A194570] N88-29480
POLAR CAPS
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194248] N88-29237
How dirty is Mars' North Polar cap, and why isn't it black N88-29677
POLAR REGIONS
Sea ice processes
[AD-A193980] N88-29262
POLARIMETERS
Investigations on multiport antennas for polarimetric and modal field scanning
[REPT-5-87] N88-29073
Development of a multiport-hybrid-mode exciter for use in antennas for polarimetric field measurements
[REPT-12-87] N88-29075
POLARIZATION (CHARGE SEPARATION)
Electron impact ionization cross-section of some organic compounds
[DE88-702044] N88-29525
POLARIZATION (SPIN ALIGNMENT)
Fluctuation and relaxation phenomena studied by means of nuclear orientation
[B8679671] N88-29534
POLARONS
Soliton and polaron dynamics in conducting polymers
[DE88-702539] N88-29035
POLICIES
Quality control in microbiology: CDC lab manual
[PB88-179890] N88-29263
SDI (Strategic Defense Initiative): A policy analysis
[AD-A194240] N88-29493
The principles of mass and maneuver applied to space operations
[AD-A194037] N88-29500
The problem of space in Soviet operational art
[AD-A194150] N88-29502
POLLUTION TRANSPORT
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230
POLOIDAL FLUX
Density fluctuations in currentless high beta plasmas in Heliotron E
[DE88-752310] N88-29550
POLYBUTADIENE
Blends of crystallizable polybutadienes
[AD-A194536] N88-29026
POLYMER CHEMISTRY
Polyazidoesters as energetic polymers and copolymer components with fluoro derivatives
[AD-A194236] N88-29039
POLYMER MATRIX COMPOSITES
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites
[UTIAS-324] N88-28970
POLYMERIC FILMS
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019
Polymeric heat pipe wick
[NASA-CASE-GSC-13019-1] N88-29133
POLYMERIZATION
Polymerization of azaethylenes (imines) and aza-1,3-dienes: Potential reactive monomers
[AD-A194717] N88-29028
POLYNOMIALS
Polynomials with restricted coefficients and their applications
[AD-A192589] N88-29055
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29467
On matrix pencil equivalents of a general polynomial matrix
[MATH-REPT-207] N88-29479

POLYTETRAFLUOROETHYLENE
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184
POLYURETHANE RESINS
Cleanability of aircraft polyurethane topcoats
[AD-A193456] N88-28878
POPULATION THEORY
Selecting the best binomial population: Parametric empirical Bayes approach
[AD-A193341] N88-29450
POROSITY
Method for maintaining precise suction strip porosities
[NASA-CASE-LAR-13638-1] N88-29051
PORPHYRINS
The design of methane activation catalysts
[DE88-002264] N88-29043
POSITION (LOCATION)
An algorithm for determining the location of points in computer simulations
[AD-A193713] N88-29343
POSITION ERRORS
Implementation of a flexible link model in a designed robot system, using the finite element method
[ETN-88-92902] N88-29303
POSITION SENSING
Motion planning for a free-flying robot N88-29378
POSITIONING
Implementation of a flexible link model in a designed robot system, using the finite element method
[ETN-88-92902] N88-29303
POTENTIAL FIELDS
Motion planning for a free-flying robot N88-29378
POTENTIAL FLOW
Accurate solutions, parameter studies and comparisons for the Euler and potential flow equations
[NASA-TM-100664] N88-28892
POWDER (PARTICLES)
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024
POWDER METALLURGY
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
POWER CONDITIONING
Power supply conditioning circuit
[NASA-CASE-NPO-17233-1-CU] N88-29095
Utilization of artificial intelligence techniques for the Space Station power system N88-29412
PRECESSION
Resonant spin-flavor precession of solar and supernova neutrinos
[DE88-752604] N88-29707
PRECISION
Aerodynamic data accuracy and quality: Requirements and capabilities in wind tunnel testing
[AGARD-AR-254] N88-28893
High definition television: Evaluation for remote task performance
[DE88-011573] N88-29057
PREDICTION ANALYSIS TECHNIQUES
Computational tools for simulation methodologies N88-28865
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
Atmospheric deposition of nitrate to the ocean surface N88-29227
On Wiener-Masani's algorithm for finding the generating function of multivariate stochastic processes
[NASA-CR-182905] N88-29481
Investigation of non-classical effects in two-photon interference processes N88-29541
PREDICTIONS
Empirical tools for simulation methodologies N88-28868
Digital phase-lock loop having an estimator and predictor of error
[NASA-CASE-NPO-17196-1-CU] N88-29076
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077
PREFLIGHT ANALYSIS
Two implementations of the Expert System for the Flight Analysis System (ESFAS) project N88-29400
PRESSURE
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515
PRESSURE DISTRIBUTION
Rotation symmetric inside flow with diametric expansion resolution
[ILR-MITT-193] N88-29123
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29618
PRESSURE EFFECTS
Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V
[DE88-006458] N88-29197
Mechanics of thrust fault formation N88-29229
Origin of SNC kaersutitic amphibole: Experimental data N88-29693
PRESSURE MEASUREMENT
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques
[DE88-006560] N88-29582
PRESSURE VESSELS
Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels
[DE88-701619] N88-29196
PRESTRESSING
Preloaded brake disc
[NASA-CASE-MSC-21132-1] N88-29181
PRINTED CIRCUITS
Procedures for identification and handling of Printed Circuit Boards (PCBs)
[AD-A191177] N88-29078
PROBABILITY DISTRIBUTION FUNCTIONS
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29487
PROBABILITY THEORY
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems
[AD-A193526] N88-29186
Mathematical algorithms for approximate reasoning N88-29418
Minimizing escape probabilities: A large deviations approach
[AD-A194534] N88-29496
Sequential approach to Colombeau's theory of generalized functions
[DE88-701869] N88-29503
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570
PROBLEM SOLVING
On recognizing ignorance N88-29372
AI tools in computer based problem solving N88-29424
Distributed knowledge base systems for diagnosis and information retrieval
[AD-A193107] N88-29633
Resonance excitation of linear and non-linear spiral density waves in a gaseous disk N88-29643
PROCESS CONTROL (INDUSTRY)
Nondestructive tests and high performance composite structures
[SNIAS-881-430-119] N88-28969
Molecular composites processing and properties, 1
[AD-A194113] N88-28974
Advanced processing and properties of high performance alloys
[AD-A193767] N88-29010
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
PRODUCT DEVELOPMENT
Development of a glass fiber wing following the construction regulation FAR Part 23
[ETN-88-92966] N88-28979
Development of a multiport-hybrid-mode exciter for use in antennas for polarimetric field measurements
[REPT-12-87] N88-29075
Next-generation space manipulator N88-29428
PROGRAM VERIFICATION (COMPUTERS)
Validation of expert systems N88-29416
PROGRAMMING LANGUAGES
Software development without languages N88-28392
Programming language concepts for multiprocessors
[AD-A193465] N88-29430
PROJECT PLANNING
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan
[AD-A194357] N88-29495
PROJECTILES
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
PROP-FAN TECHNOLOGY
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS)
[NASA-CR-175104] N88-28917
Test results at transonic speeds on a contoured over-the-wing propfan model
[NASA-TM-88206] N88-28918
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28926
Optical measurement of unducted fan blade deflections
[NASA-TM-100966] N88-29142
PROPELLANT DECOMPOSITION
Theoretical investigations of nitrocubane decomposition
[AD-A194556] N88-29047
PROPELLANT EXPLOSIONS
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008902] N88-29046
PROPELLANT TANKS
Orbital Propulsion Module (OPM). Study on coni-spherical surface tension tanks (COSTA)
[MBB-URV-170/87] N88-28963
PROPELLERS
Optical measurement of unducted fan blade deflections
[NASA-TM-100966] N88-29142
Analysis of the transmission of sound into the passenger compartment of a propeller aircraft using the finite element method
[FFA-TN-1988-15] N88-29520
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523
PROPULSION SYSTEM CONFIGURATIONS
Experimental and analytical evaluation of the effects of simulated engine inlets on the blade vibratory stresses of the SR-3 model prop-fan
[NASA-CR-174959] N88-28927
Orbital Propulsion Module (OPM). Study on coni-spherical surface tension tanks (COSTA)
[MBB-URV-170/87] N88-28963
PROTECTION
Future visual environment and concerns N88-29299
PROTECTIVE COATINGS
Ultrafine microstructure composites prepared by chemical vapor deposition
[AD-A193849] N88-28973
PROTONS
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706
PROTOTYPES
Study of Plasma Motor Generator (PMG) tether system for orbit reboost
[NASA-CR-172074] N88-28949
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137
ADP (Automated Data Processing) requirements definition and documentation through user-developed prototypes
[AD-A194407] N88-29332
PROVING
Validity of the academic aptitude composite of the Air Force Officer Qualifying Test (AFOQT)
[AD-A194753] N88-29286
Ada (trade name) compiler validation summary report: Verdix Corporation VAda-010-03205, version 5.42 MicroVAX 2 host and national DB32000 (NS32032 target
[AD-A193485] N88-29326
PSYCHOLOGICAL EFFECTS
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training
[AD-A194777] N88-29274
PSYCHOLOGICAL TESTS
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed
[AD-A193779] N88-29289
PSYCHOLOGY
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training
[AD-A194777] N88-29274
Transformations of short-term visual memory
[AD-A193873] N88-29290
PSYCHOMETRICS
Conjunctive measurement theory: Cognitive research prospects
[AD-A193627] N88-29277

PSYCHOMOTOR PERFORMANCE
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287
PSYCHOPHYSICS
Effects of psychophysical lifting training on maximal repetitive lifting capacity
[AD-A192605] N88-29271
PULSARS
Very high energy cosmic gamma rays from radio and X-ray pulsars N88-29711
PULSE AMPLITUDE MODULATION
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268
PULSE COMMUNICATION
The 44/20 GHz ground terminal
[AD-A194002] N88-29069
PULSE DIFFRACTION
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
PULSE GENERATORS
Distortions in processed signals and their application in electronic design. Part 2: A new variable signal generator
[DE88-702732] N88-29071
Distortions in processed signals and their application in electronic design. Part 3: An automated generator of communication jamming signals
[DE88-702733] N88-29072
PULSE HEATING
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
PULSED LASERS
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168
PULSES
An investigation of acoustic cavitation produced by pulsed ultrasound
[AD-A193523] N88-29516
PUMPS
Polymeric heat pipe wick
[NASA-CASE-GSC-13019-1] N88-29133
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow
[AD-A194479] N88-29162
PYROTECHNICS
Development and verification of NASA Standard Initiator-2 (NSI-2)
[NASA-CR-172069] N88-29044
Development and verification of NASA Standard Initiator-2 (NSI-2): Appendix
[NASA-CR-172070] N88-29045
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29046

Q

Q SWITCHED LASERS
Development of high efficiency q-switched glass laser via sol-gel processing
[AD-A192301] N88-29154
QUADRATIC EQUATIONS
Periodic solutions of perturbed superquadratic Hamiltonian systems
[AD-A194292] N88-29457
QUADRATURES
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
Generating semi-Gaussian two dimensional quadrature rules
[REPT-205] N88-29476
QUALITATIVE ANALYSIS
High hot-hardness gear lubricant evaluations, phase 2
[AD-A192309] N88-29017
QUALITY
Aerodynamic data accuracy and quality: Requirements and capabilities in wind tunnel testing
[AGARD-AR-254] N88-28893
High definition television: Evaluation for remote task performance
[DE88-011573] N88-29057
QUALITY CONTROL
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972
Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants
[DE88-701621] N88-29174
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
Quality control in microbiology: CDC lab manual
[PB88-179890] N88-29263
Topics in adaptive control and inference
[AD-A194718] N88-29443
QUANTUM CHROMODYNAMICS
Theoretical studies in high energy physics
[DE88-011606] N88-29538
Theoretical particle physics
[DE88-011499] N88-29621
Resonant spin-flavor precession of solar and supernova neutrinos
[DE88-752604] N88-29707
QUANTUM EFFICIENCY
High performance charge transfer device detectors
[AD-A194409] N88-28993
QUANTUM ELECTRODYNAMICS
Infrared detection using Rydberg atoms
[AD-A194308] N88-28990
Relativistic theory of the Lamb shift based on self energy
[DE88-702658] N88-29626
QUANTUM MECHANICS
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise
[AD-A193865] N88-29492
Investigation of non-classical effects in two-photon interference processes N88-29541
QUANTUM THEORY
Infrared detection using Rydberg atoms
[AD-A194308] N88-28990
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
On nonlinear equations admitting soliton solutions with a deBroglie phase
[DE88-702694] N88-29508
Towards a finite quantum gravity
[DE88-701497] N88-29619
On the meaning of perturbation expansions in quantum field theory
[DE88-702138] N88-29620
Chaotic behaviour in quantum dynamics
[AD-A193936] N88-29623
QUANTUM WELLS
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575
QUARTZ CRYSTALS
Acoustic-optical detector of gravitational waves based on high-quality crystals
[DE88-702459] N88-29232
QUENCHING (COOLING)
Estimation of transient heat transfer coefficients in multidimensional problems by using inverse heat transfer methods N88-29108
QUERY LANGUAGES
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335
QUEUEING THEORY
Relaxed heaps: An alternative to fibonacci heaps
[AD-A194030] N88-29470

R

RADAR
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079
RADAR CROSS SECTIONS
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061
RADAR FILTERS
Multi-sensory tracking mount control
[AD-A194675] N88-29339
RADAR IMAGERY
Mars earth-based radar: 1986 results and 1988-1990 opportunities N88-29697
RADAR RANGE
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061
RADAR SIGNATURES
Viking Landers and remote sensing N88-29685
RADIANCE
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3
[AD-A194670] N88-29239
RADIANT FLUX DENSITY
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration
[AD-A193825] N88-29164
RADIATION ABSORPTION
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
RADIATION CHEMISTRY
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019
RADIATION COUNTERS
Large area nuclear particle detectors using ET materials
[NASA-CR-180777] N88-29136
RADIATION DISTRIBUTION
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066
RADIATION DOSAGE
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
RADIATION EFFECTS
Avionics system design for high energy fields: A guide for the designer and airworthiness specialist
[NASA-CR-181590] N88-28919
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268
Vision and visual protection in fast jet aircraft N88-29292
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
RADIATION PROTECTION
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
RADIATION SICKNESS
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267
RADIATION TOLERANCE
Optical emission behavior and radiation resistance of epoxy resins
[DE88-752629] N88-29023
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267
RADIATIVE TRANSFER
Infrared detection using Rydberg atoms
[AD-A194308] N88-28990
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
RADIO ASTRONOMY
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-182443] N88-29653
RADIO EQUIPMENT
Random-access algorithms for environments with capture
[AD-A194303] N88-29060
RADIO FREQUENCIES
Bootstrap currents in radio-frequency-driven tokamak equilibria
[DE88-011136] N88-29561
RADIO OCCULTATION
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-182443] N88-29653
RADIO SIGNALS
Indian Ocean validation
[AD-A194458] N88-28902
RADIOACTIVE ISOTOPES
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019

RADIOACTIVITY
Radioactivity as a means of nondestructive testing
[DE86-702778] N88-29188
RADIOGRAPHY
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
RADIOMETERS
Microwave frequency nondestructive control
[CERT-2/1355-MO] N88-28976
Improvements in techniques of microwave thermography
[AD-A194613] N88-29062
RAIN
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077
Effects of precipitation on wind turbine performance
[DE88-001144] N88-29211
RAMAN SPECTRA
Soliton and polaron dynamics in conducting polymers
[DE86-702539] N88-29035
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141
RAMAN SPECTROSCOPY
Raman spectroscopy on simple molecular systems at very high density
[DE88-010947] N88-28967
RANDOM ACCESS MEMORY
Random-access algorithms for environments with capture
[AD-A194303] N88-29060
RANDOM VARIABLES
Strong law for mixing sequence
[AD-A193815] N88-29490
RAPID QUENCHING (METALLURGY)
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591
RARE EARTH COMPOUNDS
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR
[DE88-752611] N88-29588
RARE EARTH ELEMENTS
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599
RATES (PER TIME)
Systolic array fault tolerance performance analysis
[AD-A193521] N88-29306
RAYLEIGH DISTRIBUTION
A multiple-scales partial solution of the pulse-forced Rayleigh-Plesset equation of cavitation bubble dynamics
[AD-A193733] N88-29118
REACTION KINETICS
Thermodynamic data bases for multivalent elements: An example for ruthenium
[DE88-004395] N88-28984
Theoretical investigations of nitrocubane decomposition
[AD-A194556] N88-29047
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow
[AD-A194493] N88-29163
Chemical kinetics of hydrogen and P(sub b) centers
[DE88-010528] N88-29594
REACTOR SAFETY
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
REACTOR TECHNOLOGY
Fusion product spectra
[DE86-010912] N88-29554
REAGENTS
Method of dispensing reagent chemicals in space
[NASA-CASE-LAR-13607-1-CU] N88-29048
REAL TIME OPERATION
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138
Machine vision for real time orbital operations
N88-29367
Intelligent test integration system N88-29371
Distributed cooperating processes in a mobile robot control system N88-29386
An expert system for a distributed real-time trainer
N88-29411
Real-time space system control with expert systems
N88-29419
Semantic based man-machine interface for real-time communication N88-29421
Parallel real-time expert systems
[AD-A193673] N88-29434
RECOGNITION
Visual motion perception and visual attentive processes
[AD-A193640] N88-29268
RECOMBINATION REACTIONS
Influence of the temperature-dependence of recombination life-time of free carriers in amorphous semiconductors on thermostimulated photocurrent spectra
[DE88-702728] N88-29609
RECOMMENDATIONS
Flight information publication (FLIP) feedback
[AD-A194462] N88-28897
RECORDS
An introduction to the historical records of China about Mars N88-29664
RECRYSTALLIZATION
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591
RECTANGULAR WIND TUNNELS
Flow visualization on a small scale
[AD-A194728] N88-28935
RECURSIVE FUNCTIONS
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics
[NASA-CR-182516] N88-29328
Adaptive identification by systolic arrays
[AD-A193532] N88-29444
RED SHIFT
Gravitational redshift of self-gravitating systems of dark matter in the universe
[DE88-702688] N88-29650
REDUCTION (CHEMISTRY)
Super hydrides
[AD-A193710] N88-28995
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168
REENTRY VEHICLES
Study of hypersonic boundary layers
[CERT-RSF-OA-17/5005-AYD] N88-29121
REFINING
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems
[AD-A193560] N88-29464
REFLECTANCE
Seismic reflection experiments imaging the physical nature of crustal structures in southern California
N88-29235
Mars: Spectral signatures seen and unseen
N88-29659
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683
The surface composition of Mars from earthbased observations N88-29696
Martian surface analogs: Laboratory spectral studies in the mid infrared N88-29699
REFLECTION
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517
REFRACTORY MATERIALS
Very high temperature materials for mechanical application
[SNIAS-881-430-106] N88-28978
REFRIGERATORS
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
REFUELING
Inflight rearming
[AD-A193564] N88-28909
REGIONS
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2
[DE88-010416] N88-29248
REGOLITH
Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29666
Some probable characteristics of the Martian regolith
N88-29678
REGRESSION ANALYSIS
Two biased estimation techniques in linear regression: Application to aircraft
[NASA-TM-100649] N88-29489
REINFORCING FIBERS
Elastic wave dispersion in laminated composite plate
[AD-A192289] N88-28967
RELATIVISTIC PARTICLES
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624
RELATIVISTIC THEORY
Relativistic theory of the Lamb shift based on self energy
[DE88-702658] N88-29626
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706
RELATIVISTIC VELOCITY
A study of mechanisms producing astrophysical jets
[AD-A194100] N88-29649
RELATIVITY
Time travel in the homogeneous Som-Raychaudhuri universe
[DE88-702220] N88-29622
On neutrino fields in Einstein-Cartan theory
[MATH-REPT-208] N88-29629
RELAXATION METHOD (MATHEMATICS)
Relaxed heaps: An alternative to fibonacci heaps
[AD-A194030] N88-29470
RELIABILITY
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972
Reliability assessment of Surface Mount Technology (SMT)
[AD-A193759] N88-29089
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems
[AD-A193526] N88-29186
Reliability and Maintainability (R and M)
[AD-A193857] N88-29187
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed
[AD-A193779] N88-29289
A minitab macro for the Kaplan-Meier product limit estimator and the Tarone-Ware class of tests
[AD-A194298] N88-29331
An expert system for reliability modeling N88-29355
Exact lower confidence limits for the reliability of k of n systems for zero failures and nonconservativeness of the maximus method
[AD-A194299] N88-29485
RELIABILITY ANALYSIS
Approximate evaluation of semi-Markov chain reliability models
[AD-A194669] N88-29185
RELIABILITY ENGINEERING
Expert systems for MSFC power systems N88-29375
Blackboard architectures and their relationship to autonomous space systems N88-29414
A nonlinear filtering process diagnostic system for the Space Station N88-29417
REMOTE CONTROL
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177
REMOTE MANIPULATOR SYSTEM
Remote servicing of space systems N88-29409
A teleoperated robotic manipulator system for materials processing experiment servicing N88-29410
REMOTE SENSING
Spectral characteristics and the extent of paleosols of the Palouse formation
[NASA-CR-180947] N88-29210
Activities report in remote sensing
[ETN-88-92905] N88-29714
REPORTS
Activities report in remote sensing
[ETN-88-92905] N88-29714
REQUIREMENTS
Model test of air-exchange efficiency
[DE88-752882] N88-29049
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177
Night lighting and night vision goggle compatibility
N88-29297

RESEARCH AIRCRAFT
Investigations into the triggered lightning response of the F106B thunderstorm research aircraft
[NASA-CR-3902] N88-29258
RESEARCH AND DEVELOPMENT
A study of the National Physics Laboratory microdosimetry research programme in collaboration with the University of Leeds (United Kingdom)
[NPL-RS(EXT)-93] N88-29148
Competition: Issued on establishing and using Federally funded research and development centers
[PB88-178884] N88-29632
RESEARCH FACILITIES
The NBS/NRL (National Bureau of Standards/Naval Research Laboratory) free electron laser facility
[AD-A194214] N88-29159
Center for opto-electronic systems research instrumentation grant
[AD-A193711] N88-29545
RESEARCH MANAGEMENT
Development and verification of NASA Standard Initiator-2 (NSI-2)
[NASA-CR-172069] N88-29044
Development and verification of NASA Standard Initiator-2 (NSI-2): Appendix
[NASA-CR-172070] N88-29045
SERI's photovoltaic research project: A foundation for tomorrow's utility-scale electricity
[DE88-001181] N88-29220
Competition: Issued on establishing and using Federally funded research and development centers
[PB88-178884] N88-29632
Argonne National Laboratory technology transfer report, FY87
[DE88-010091] N88-29639
Activities report in remote sensing
[ETN-88-92905] N88-29714
RESERVOIRS
Unstable heat pipes
[DE88-010780] N88-29217
RESIDUAL STRESS
Thin film-residual stress assessment
[AD-A193205] N88-29018
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
RESOLUTION
The complexity of AI algorithms
[AD-A193494] N88-29438
RESONANCE
Resonance excitation of linear and non-linear spiral density waves in a gaseous disk N88-29643
RESONANT FREQUENCIES
Measure of hydrogen concentration profile in materials by resonant nuclear reactions
[DE88-702599] N88-28999
Effects on the resonant frequencies caused by loading a spherical cavity with a dielectric sphere
[AD-A193864] N88-29511
RESOURCES MANAGEMENT
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194625] N88-28941
A scheduling and resource management system for space applications N88-29383
Intelligent resource management for local area networks: Approach and evolution N88-29385
RESPONSE BIAS
A nonparametric multidimensional IRT approach with applications to ability estimation and test bias
[AD-A194212] N88-29483
RESPONSE TIME (COMPUTERS)
Concepts for robot motion primitives required for space station teleoperations N88-29387
RETENTION (PSYCHOLOGY)
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266
RETROFITTING
Aircraft avionics and missile system installation cost study. Volume 1: Technical report and appendices A through E
[AD-A194605] N88-28923
REUSE
Automated software development workstation N88-29423
REYNOLDS NUMBER
Reynolds number effects and the wind tunnel environment N88-28862
Experimental tools: The tunnel and the model N88-28864
RF-4 AIRCRAFT
Future air-to-air training for the RF-4
[AD-A194363] N88-29284
RHEOLOGY
A review: Quantitative models for lava flows on Mars N88-29656
Photogeological inferences of Martian surface composition N88-29675
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676
RIGID ROTOR HELICOPTERS
Time periodic control of a multi-blade helicopter
[AD-A194435] N88-28931
RIGID STRUCTURES
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics
[NASA-CR-182516] N88-29328
ROADS
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis
[AD-A192399] N88-29208
ROBOTICS
Motion planning with obstacles and dynamic constraints N88-29175
Study on design and control of torque-controlled manipulators
[NASA-TT-20197] N88-29183
Implementation of a flexible link model in a designed robot system, using the finite element method
[ETN-88-92902] N88-29303
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-86-62] N88-29352
Machine vision for real time orbital operations N88-29367
A plan for time-phased incorporation of automation and robotics on the US space station N88-29377
The use of computer graphic simulation in the development of robotic systems N88-29388
A robotic system for automation of logistics functions on the Space Station N88-29407
A teleoperated robotic manipulator system for materials processing experiment servicing N88-29410
Next-generation space manipulator N88-29428
ROBOTS
Motion planning for legged locomotion systems on uneven terrain N88-29170
Implementation of a flexible link model in a designed robot system, using the finite element method
[ETN-88-92902] N88-29303
Motion planning for a free-flying robot N88-29378
Distributed cooperating processes in a mobile robot control system N88-29386
Concepts for robot motion primitives required for space station teleoperations N88-29387
Personnel occupied woven envelope robot N88-29408
Remote servicing of space systems N88-29409
ROBUSTNESS (MATHEMATICS)
Robust control of multivariable and large scale systems
[AD-A194250] N88-29441
ROCKET EXHAUST
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system
[NASA-CR-178974] N88-28965
ROCKET NOSE CONES
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system
[NASA-CR-178974] N88-28965
ROCKET NOZZLES
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
ROLLERS
A study of the floating roller peel test for adhesives
[AD-A194114] N88-29034
ROOM TEMPERATURE
Relation between strength, creep and relaxation behavior in Cu and Al at room temperature
[ETN-88-92962] N88-29015
ROTARY WINGS
An unsteady helicopter rotor: Fuselage interaction analysis
[NASA-CR-4178] N88-28880
ROTATING LIQUIDS
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
ROTATING SHAFTS
Development of high temperature, high pressure rotating shaft seals
[DE88-001029] N88-29172
ROTATING STALLS
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112
Modeling of large stall in axial compressors
[VKI-NT-164] N88-29124
ROTATION
Development of high temperature, high pressure rotating shaft seals
[DE88-001029] N88-29172
ROTOR BLADES (TURBOMACHINERY)
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28928
ROTORS
Investigation of helicopter rotor blade/wake interactive impulsive noise
[NASA-CR-177435] N88-28882
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
ROUGHNESS
Green's function approach to roughening transition of one-dimensional restricted solid on solid model
[DE88-702723] N88-29512
ROUTES
Indian Ocean validation
[AD-A194458] N88-28902
RUBBER
Elastic behavior of a rubber layer bonded between two rigid spheres
[AD-A193698] N88-29030
RULES
Generating semi-Gaussian two dimensional quadrature rules
[REPT-205] N88-29476
RUNNING
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29281
RUNWAYS
Improvement of head-up display standards. Volume 5: Head up display ILS (Instrument Landing System) accuracy flight tests
[AD-A194602] N88-28922
Airport surface traffic automation study
[AD-A194553] N88-28934
RUPTURING
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
RUTHENIUM
Thermodynamic data bases for multivalent elements: An example for ruthenium
[DE88-004395] N88-28984

S

SAFETY
Avionics system design for high energy fields: A guide for the designer and airworthiness specialist
[NASA-CR-181590] N88-28919
SAGE SATELLITE
European validation of SAGE-2 aerosol profiles
[AERONOMICA-ACTA-A-327-1988] N88-29243
SALYUT SPACE STATION
The Soviet MIR space station
[AD-A194040] N88-28951
SAMPLING
Elemental composition of the Martian surface N88-29665
Viking Landers and remote sensing N88-29685
SATELLITE ATTITUDE CONTROL
Study of a safe attitude for the Infrared Space Observatory (ISO) during perigee pass
[SNIAS-881-440-113] N88-28954
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29381
SATELLITE COMMUNICATION
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077
SATELLITE IMAGERY
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
Surface composition of Mars: A Viking multispectral view N88-29655

The history of Martian volcanism determined from a revised relative chronology N88-29657
High resolution Viking Orbiter images: A useful data source for testing the viability of geomorphic processes attributed to Martian landforms N88-29703

SATELLITE NETWORKS
NOA: A Network Operator Assistant for scheduling Tracking and Data Relay Satellite System (TDRSS) N88-29403

SATELLITE SOUNDING
Snapshots of high-latitude electrodynamics using Viking and DMSP/F7 observations
[TRITA-EPP-88-01] N88-29244

SATELLITE-BORNE PHOTOGRAPHY
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250

SCALE MODELS
Flow visualization on a small scale
[AD-A194728] N88-28935
Model test of air-exchange efficiency
[DE88-752862] N88-29049

SCALING LAWS
Faster scaling algorithms for network problems
[AD-A194032] N88-29348

SCANNING
Investigations on multiport antennas for polarimetric and modal field scanning
[REPT-5-87] N88-29073

SCATTERING CROSS SECTIONS
Effect of a laser field in the electron inelastic scattering into plasma fields
[DE88-702295] N88-29157
Neutrino detection primer
[AD-A193805] N88-29529

SCHEDULES
Inflight rearming
[AD-A193564] N88-28909

SCHEDULING
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194625] N88-28941
A knowledge-based decision support system for payload scheduling N88-29358
A scheduling and resource management system for space applications N88-29383
A space station onboard scheduling assistant N88-29402
NOA: A Network Operator Assistant for scheduling Tracking and Data Relay Satellite System (TDRSS) N88-29403
Experiment scheduling for Spacelab missions N88-29404

SCHOTTKY DIODES
Blue-green laser diode research program
[AD-A191980] N88-29153

SEA ICE
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251
Sea ice processes
[AD-A193980] N88-29262
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517

SEALS (STOPPERS)
Development of high temperature, high pressure rotating shaft seals
[DE88-001029] N88-29172

SEARCH PROFILES
A flexible search strategy for production systems N88-29420

SEASONS
Typical weather months in the past (1973-1983) in Central Europe
[AD-A194701] N88-29249

SECONDARY EMISSION
Plasma theory and simulation
[AD-A194674] N88-29565

SECONDARY RADAR
Fine resolution errors in secondary surveillance radar altitude reporting
[RSRE-87019] N88-28906

SECRETIONS
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29281

SEDIMENTS
The Martian sedimentary record N88-29669
Surface units on Mars: The assemblage in the Valles Marineris N88-29680
Early cratering rates and the nature of the Martian cratered uplands N88-29694

SEEPAGE
Nonseismic, surface geophysical and geochemical prospecting technology
[PB88-196613] N88-29207

SEISMIC WAVES
Seismic reflection experiments imaging the physical nature of crustal structures in southern California N88-29235

SELECTION RULES (NUCLEAR PHYSICS)
On selection rules and inelastic electron scattering at intermediate energies
[DE88-701833] N88-29526

SELF MANEUVERING UNITS
Personnel occupied woven envelope robot N88-29408

SELF ORGANIZING SYSTEMS
Hierarchical organization for large, dynamic radio networks
[AD-A193942] N88-29067
Radial basis functions, multi-variable functional interpolation and adaptive networks
[RSRE-MEMO-4148] N88-29436

SEMANTICS
Unification and set-valued functions for functional and logic programming
[AD-A193643] N88-29341
Validation of expert systems N88-29416
Semantic based man-machine interface for real-time communication N88-29421
An expert system for natural language processing N88-29426

SEMICONDUCTING FILMS
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595

SEMICONDUCTOR DEVICES
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29046
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575

SEMICONDUCTOR DIODES
Blue-green laser diode research program
[AD-A191980] N88-29153

SEMICONDUCTOR LASERS
Blue-green laser diode research program
[AD-A191980] N88-29153

SEMICONDUCTORS (MATERIALS)
DARPA-URI consortium meetings on submicron heterostructures of diluted magnetic semiconductors
[AD-A193499] N88-29081
The diamond as a new electronic material
[NASA-TT-20354] N88-29098
Local environment approach for deep-level defects in semiconductors: Application to the vacancy in silicon
[DE88-702017] N88-29573
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques
[DE88-008560] N88-29582
Electronic states in tunneling semiconductor superlattices
[DE88-011571] N88-29587
Study of superconducting properties in some many valley semiconductors
[DE88-702325] N88-29593
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600
Hot electron emission in semiconductors
[AD-A194101] N88-29601
System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice
[DE88-702686] N88-29606
Vibration spectra induced by impurities in 3-5-compounds semiconductors
[DE88-702730] N88-29610

SENSITIVITY
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019
Acoustic-optical detector of gravitational waves based on high-quality crystals
[DE88-702459] N88-29232
Phase sensitive amplification with SIS (Superconductor-Insulator-Superconductor) quasiparticle mixers
[AD-A194594] N88-29596

SENSORIMOTOR PERFORMANCE
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272

SENSORS
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947

SEPARATED FLOW
Development and analysis of turbulent non-equilibrium boundary layers N88-28872
Shock boundary layer interaction N88-28873
Classical separation, trailing-edge flows and buffeting N88-28874
Vortex flows N88-28875
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114

SEQUENCING
Strong law for mixing sequence
[AD-A193615] N88-29490

SERIES EXPANSION
Solution of large order Fourier-Bessel equations
[ARE-TM(UHA)-88504] N88-29475
On the meaning of perturbation expansions in quantum field theory
[DE88-702136] N88-29620

SERVICE LIFE
Life-span knowledge engineering for space operations N88-29401

SERVOCONTROL
Study on design and control of torque-controlled manipulators
[NASA-TT-20197] N88-29183

SERVOMECHANISMS
Study on design and control of torque-controlled manipulators
[NASA-TT-20197] N88-29183

SET THEORY
Multicriteria integer programming for problems involving linear and nonlinear utility functions
[AD-A194530] N88-29336
Unification and set-valued functions for functional and logic programming
[AD-A193643] N88-29341
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413
Mathematical algorithms for approximate reasoning N88-29418
Practical higher-order functional and logic programming based on lambda-calculus and set-abstraction
[AD-A193645] N88-29466

SHAFTS (MACHINE ELEMENTS)
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system
[NASA-CR-178974] N88-28965

SHALLOW SHELLS
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191

SHEAR LAYERS
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28896

SHEAR PROPERTIES
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
Kinetic theory for electrostatic waves due to transverse velocity shears
[AD-A193404] N88-29557

SHEAR STRAIN
Improved finite strip Mindlin plate bending element using assumed shear strain distributions
[NASA-TM-100928] N88-29195

SHEAR STRESS
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577

SHEATHS
Collector and source sheaths of a finite ion temperature plasma
[DE88-008934] N88-29584

SHELL STABILITY
Thickness effects on the stability of shell like structures N88-29192

SHELLS (STRUCTURAL FORMS)
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200

SHOCK TUNNELS
A numerical study of the test time in a hypersonic shock tunnel
[AD-A194057] N88-28888

SHOCK WAVE INTERACTION
Shock boundary layer interaction N88-28873
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields
[AD-A194191] N88-28883
Shock waves in unsteady flows
[NASA-TT-20329] N88-29134

SHOCK WAVE PROFILES
Theoretical and experimental investigations on the structure of stationary shock waves in gas particle dispersions
[ETN-88-92983] N88-29122
Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V
[DE88-006458] N88-29197
SHOCK WAVES
Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V
[DE88-006458] N88-29197
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706
SHORELINES
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193960] N88-29251
SICKNESSES
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training
[AD-A194777] N88-29274
SIDE INLETS
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936
SIERRA LEONE
Global solar radiation in Sierra Leone (West Africa)
[DE88-702725] N88-29252
SIGNAL ANALYSIS
Artificial intelligence applied to process signal analysis N88-29359
SIGNAL DETECTION
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
Evaluation of atmospheric effects for operational tactical decision aid
[AD-A194205] N88-29236
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29446
SIGNAL GENERATORS
Results of the use of an automated electrical measuring instrument calibration system
[SNIAS-881-430-107] N88-29146
SIGNAL PROCESSING
Method and apparatus for non-destructive testing of temper embrittlement in steels
[NASA-CASE-LAR-13817-1] N88-29012
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079
Anti-aliasing filters for dynamics and control experiments
[AD-A193758] N88-29203
A computer program package for introductory one-dimensional digital signal processing applications
[AD-A194656] N88-29338
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487
SIGNAL TO NOISE RATIOS
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061
Multi-sensory tracking mount control
[AD-A194675] N88-29339
SIGNATURE ANALYSIS
Variability in spectral signatures of terrestrial volcanic rocks and implications for volcanology on Mars N88-29672
SIGNS AND SYMPTOMS
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272
SILANES
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
SILICA GLASS
Development of high efficiency q-switched glass laser via sol-gel processing
[AD-A192301] N88-29154
SILICON
Sol-gel kinetics: Si(sup)29 NMR and a statistical reaction model
[DE88-011545] N88-28988
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
Local environment approach for deep-level defects in semiconductors: Application to the vacancy in silicon
[DE88-702017] N88-29573
SILICON CARBIDES
Investigation of a SiC/Ti-24Al-11Nb composite
[NASA-TM-100956] N88-28980
Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum hydroxide
[NASA-TT-20332] N88-29003
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
SILICON COMPOUNDS
Photorefractive damage mechanism in electro-optic materials
[AD-A194560] N88-29543
SILICON NITRIDES
The high temperature creep deformation of Si3N4-6Y2O3-2Al2O3
[NASA-CR-183204] N88-28981
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024
SILICON POLYMERS
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
SILOXANES
Quasi-liquid crystalline materials with special electro-optic properties
[AD-A194579] N88-29544
SIMULATION
Boundary layer simulation and control in wind tunnels
[AGARD-AR-224] N88-28857
Missiles, fuselage and similar bodies N88-28858
Empirical tools for simulation methodologies N88-28866
Transport-type configurations N88-28867
Introduction and critical flow phenomena N88-28870
Shock boundary layer interaction N88-28873
Classical separation, trailing-edge flows and buffeting N88-28874
Vortex flows N88-28875
Boundary layer manipulation N88-28877
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
Typical weather months in the past (1973-1983) in Central Europe
[AD-A194701] N88-29249
The gradient method for interface tracking
[AD-A194477] N88-29334
Fusion product spectra
[DE88-010912] N88-29554
Systematic properties of clusters of galaxies in different cosmological scenarios N88-29646
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-182443] N88-29653
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701
SINGLE CRYSTALS
Preparation and testing of Nb-Zr and Nb-ZrO2 single crystals for deformation studies
[DE88-702798] N88-29613
SINGULARITY (MATHEMATICS)
A singular perturbation analysis of the weakly nonlinear evolution of long and short water waves and waves in boundary layers N88-29102
A minimax method for a class of Hamiltonian systems with singular potentials
[AD-A193478] N88-29453
SITE SELECTION
Geology of six possible Martian landing sites N88-29682
SKIN FRICTION
Skin friction balance
[NASA-CASE-LAR-13710-1] N88-29145
SLENDER BODIES
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence
[FFA-TN-1988-02] N88-29126
SLENDER WINGS
High-aspect-ratio wings N88-28859
Delta wing configurations N88-28860
SLIDING FRICTION
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176
SMOKE
Smoke hoods: Net safety benefit analysis — aircraft accidents
[CAA-PAPER-87017] N88-28898
Flow visualization on a small scale
[AD-A194726] N88-28935
Flow visualization by laser sheet
[AD-A194481] N88-29111
SODIUM SULFUR BATTERIES
Considerations and measurements of latent-heat-storage salts for secondary thermal battery applications
[DE88-011091] N88-29213
SOFTWARE ENGINEERING
The SMITE object oriented backing store
[RSRE-MEMO-4147] N88-29308
Investigation of the use of High Order Languages (HOLs) for on-board software
[CRI/FR/HOL-C/1/87] N88-29349
A software engineering approach to expert system design and verification N88-29356
Automated software development workstation N88-29423
An expert system for natural language processing N88-29426
Advanced information processing system: Input/output network management software
[NASA-CR-181878] N88-29431
Central user and browse service — ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637
SOFTWARE TOOLS
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
Software development without languages N88-29392
Knowledge based programming environments: A perspective N88-29393
Requirements for a tool to aid in the development of expert systems for space station applications N88-29398
Benchmarking expert system tools N88-29399
Two implementations of the Expert System for the Flight Analysis System (ESFAS) project N88-29400
A flexible search strategy for production systems N88-29420
AI tools in computer based problem solving N88-29424
Networking and AI systems: Requirements and benefits N88-29425
Expert system technology as a data processing tool N88-29427
Artificial intelligence software acquisition program, volume 1
[AD-A194104] N88-29447
Central user and browse service — ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637
SOI (SEMICONDUCTORS)
Evaluation of silicon-on-insulator MOS (Metal-Oxide-Semiconductor) transistor response to 10-keV X-ray and cobalt-60 irradiation
[DE88-006102] N88-29062
SOILS
Nonseismic, surface geophysical and geochemical prospecting technology
[PB88-196613] N88-29207
Spectral characteristics and the extent of paleosols of the Palouse formation
[NASA-CR-180947] N88-29210
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-006368] N88-29225
Viking Landers and remote sensing N88-29685
The surface composition of Mars from earthbased observations N88-29696
SOL-GEL PROCESSES
Sol-gel kinetics: Si(sup)29 NMR and a statistical reaction model
[DE88-011545] N88-28988
The sol-gel synthesis of ceramics
[SNIAS-881-430-114] N88-29037
Al2O3-TiO2 and Al2TiO5 ceramic materials
[SNIAS-881-430-122] N88-29038
Development of high efficiency q-switched glass laser via sol-gel processing
[AD-A192301] N88-29154
SOLAR ARRAYS
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-28959

SOLAR CELLS
Theoretical investigation on heterojunction solar cell
[DE88-701837] N88-29219
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222
Long-term behavior of energy production systems with the example of HELIOS and SYMPHONIE
[ETN-88-92988] N88-29223
SOLAR COLLECTORS
Lewis Research Center space station electric power system test facilities
[NASA-TM-100924] N88-28942
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222
SOLAR CORONA
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29706
SOLAR CYCLES
Basic causes of amplitude modulation in climatic/weather parameters
[DE88-702743] N88-29254
Neutrino electrodynamics and possible effects for solar neutrinos
[DE88-701647] N88-29705
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29706
SOLAR DYNAMIC POWER SYSTEMS
Solar dynamic power systems
[ETN-88-92969] N88-29224
SOLAR ENERGY CONVERSION
SERI's photovoltaic research project: A foundation for tomorrow's utility-scale electricity
[DE88-001161] N88-29220
SOLAR FLARES
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706
SOLAR FLUX DENSITY
Short term variability between 120 and 300 mm from Solar Mesosphere Explorer (SME) observations
[AERONOMICA-ACTA-A-328-1988] N88-29709
SOLAR GENERATORS
SERI's photovoltaic research project: A foundation for tomorrow's utility-scale electricity
[DE88-001161] N88-29220
SOLAR MESOSPHERE EXPLORER
Short term variability between 120 and 300 mm from Solar Mesosphere Explorer (SME) observations
[AERONOMICA-ACTA-A-328-1988] N88-29709
SOLAR NEUTRINOS
Neutrino electrodynamics and possible effects for solar neutrinos
[DE88-701647] N88-29705
Resonant spin-flavor precession of solar and supernova neutrinos
[DE88-752604] N88-29707
SOLAR RADIATION
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247
Global solar radiation in Sierra Leone (West Africa)
[DE88-702725] N88-29252
Mathematical correlation between variations in solar radiation parameters. Part 1: Daily sums of global radiation and midday global radiation
[DE88-702742] N88-29253
Basic causes of amplitude modulation in climatic/weather parameters
[DE88-702743] N88-29254
Short term variability between 120 and 300 mm from Solar Mesosphere Explorer (SME) observations
[AERONOMICA-ACTA-A-328-1988] N88-29709
SOLAR REFLECTORS
Planarization of metal substrates for solar mirrors
[DE88-011492] N88-29214
SOLID ELECTROLYTES
Polymeric electrolytes
[AD-A193766] N88-29031
SOLID LUBRICANTS
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184
SOLID PROPELLANT ROCKET ENGINES
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 1
[NASA-CR-178973] N88-28964
SOLID STATE DEVICES
Space-charge-wave solid state microwave amplifier
[AD-A193792] N88-29091
Phase sensitive amplification with SIS (Superconductor-Insulator-Superconductor) quasiparticle mixers
[AD-A194594] N88-29596
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
SOLID STATE LASERS
Solid-state laser research report: Energy transfer in non-uniform codoped crystals
[AD-A194358] N88-29161
SOLID-SOLID INTERFACES
Green's function approach to roughening transition of one-dimensional restricted solid on solid model
[DE88-702723] N88-29512
SOLIDIFICATION
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
SOLITARY WAVES
The construction of implicit and explicit solitary wave solutions of nonlinear partial differential equations
[AD-A193475] N88-29452
On nonlinear equations admitting soliton solutions with a deBrogle phase
[DE88-702694] N88-29508
SOLUTIONS
The construction of implicit and explicit solitary wave solutions of nonlinear partial differential equations
[AD-A193475] N88-29452
Weak solution of the Langevin equation on a generalized functional space
[AD-A194290] N88-29456
SOLVENTS
Hydrogen storage by molecular polyhydrides
[AD-A194207] N88-28989
SONAR
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079
SOOT
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138
SOUND FIELDS
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518
SOUND PRESSURE
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518
SOUND TRANSMISSION
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518
Analysis of the transmission of sound into the passenger compartment of a propeller aircraft using the finite element method
[FFA-TN-1988-15] N88-29520
SPACE
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-86-62] N88-29352
SPACE CHARGE
Space-charge-wave solid state microwave amplifier
[AD-A193792] N88-29091
Beam optics test stand
[AD-A193901] N88-29144
SPACE DEBRIS
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-28959
SPACE ENVIRONMENT SIMULATION
Contribution to the study of materials behavior in space environment
[SNIAS-881-430-104] N88-28977
SPACE ERECTABLE STRUCTURES
Development of a space deployable radiator using heat pipes
[SNIAS-881-440-104] N88-29128
SPACE FLIGHT TRAINING
An expert system for a distributed real-time trainer
N88-29411
SPACE LOGISTICS
A robotic system for automation of logistics functions on the Space Station N88-29407
SPACE MAINTENANCE
Remote servicing of space systems N88-29409
SPACE MISSIONS
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194825] N88-28941
The principles of mass and maneuver applied to space operations
[AD-A194037] N88-29500
SPACE OBSERVATIONS (FROM EARTH)
The surface composition of Mars from earthbased observations N88-29696
Mars earth-based radar: 1986 results and 1988-1990 opportunities N88-29697
SPACE PERCEPTION
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288
SPACE PLATFORMS
Defensive platform size and survivability
[DE88-011634] N88-28948
Analytical investigation of the dynamics of tethered constellations in earth orbit
[NASA-CR-179371] N88-28950
Expandable pallet for space station interface attachments
[NASA-CASE-MSC-21117-1] N88-28958
SPACE POWER REACTORS
Lewis Research Center space station electric power system test facilities
[NASA-TM-100924] N88-28942
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28960
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
SPACE PROCESSING
Method of dispensing reagent chemicals in space
[NASA-CASE-LAR-13607-1-CU] N88-29048
Optimization of low gravity materials processing experiments using expert systems N88-29361
A generic expert system for materials processing in space N88-29376
A teleoperated robotic manipulator system for materials processing experiment servicing N88-29410
SPACE RENDEZVOUS
A software engineering approach to expert system design and verification N88-29356
SPACE SHUTTLE MAIN ENGINE
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184
SPACE SHUTTLES
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881
Progress on a Monte Carlo shuttle contamination model
[AD-A193694] N88-28945
Preloaded brake disc
[NASA-CASE-MSC-21132-1] N88-29181
SPACE STATION PAYLOADS
A knowledge-based decision support system for payload scheduling N88-29358
SPACE STATION POWER SUPPLIES
Lewis Research Center space station electric power system test facilities
[NASA-TM-100924] N88-28942
Expert systems for MSFC power systems N88-29375
Utilization of artificial intelligence techniques for the Space Station power system N88-29412
SPACE STATIONS
Ariane 5, HERMES and European vehicles for space station servicing
[SNIAS-881-422-102] N88-28943
Space transportation nodes assumptions and requirements: Lunar base systems study task 2.1
[NASA-CR-172052] N88-28944
Expandable pallet for space station interface attachments
[NASA-CASE-MSC-21117-1] N88-28958
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-28959
Collet lock joint for space station truss
[NASA-CASE-MSC-21207-1] N88-29180
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
A plan for time-phased incorporation of automation and robotics on the US space station N88-29377
A space station onboard scheduling assistant N88-29402
A robotic system for automation of logistics functions on the Space Station N88-29407

SPACE SURVEILLANCE (GROUND BASED)
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation
[AD-A193745] N88-29499
SPACE TRANSPORTATION SYSTEM
Space transportation nodes assumptions and requirements: Lunar base systems study task 2.1
[NASA-CR-172052] N88-28944
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 1
[NASA-CR-178973] N88-28964
SPACE WEAPONS
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan
[AD-A194357] N88-29495
SPACE-TIME FUNCTIONS
Open bosonic string in background electromagnetic field
[DE88-702140] N88-29053
Time travel in the homogeneous Som-Raychaudhuri universe
[DE88-702220] N88-29622
SPACECRAFT CONFIGURATIONS
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881
SPACECRAFT CONSTRUCTION MATERIALS
Contribution to the study of materials behavior in space environment
[SNIAS-881-430-104] N88-28977
Very high temperature materials for mechanical application
[SNIAS-881-430-106] N88-28978
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
SPACECRAFT CONTAMINATION
Progress on a Monte Carlo shuttle contamination model
[AD-A193694] N88-28945
SPACECRAFT CONTROL
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Intelligent interfaces for expert systems N88-29397
SPACECRAFT DESIGN
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-86-62] N88-29352
SPACECRAFT DOCKING
OMV docking simulator N88-29379
SPACECRAFT EQUIPMENT
Surface Tension Confined Liquid Cryogen Cooler (STCLCC)
[NASA-CASE-GSC-13112-1] N88-29050
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
SPACECRAFT GUIDANCE
Time minimal computation of feedback control schemes for optimal guidance problems used in space flight
[ETN-88-92989] N88-28953
SPACECRAFT PERFORMANCE
A scheduling and resource management system for space applications N88-29383
SPACECRAFT POWER SUPPLIES
Arcjet power supply and start circuit
[NASA-CASE-LEW-14374-1] N88-28939
Thin film coatings for space electrical power system applications
[NASA-TM-101325] N88-28966
Solar dynamic power systems
[ETN-88-92969] N88-29224
SPACECRAFT PROPULSION
Orbital Propulsion Module (OPM). Study on coni-spherical surface tension tanks (COSTA)
[MBB-URV-170/87] N88-28963
SPACECRAFT RADIATORS
Development of a space deployable radiator using heat pipes
[SNIAS-881-440-104] N88-29128
SPACECRAFT RELIABILITY
A scheduling and resource management system for space applications N88-29383
SPACECRAFT STRUCTURES
Nondestructive investigations for space use
[SNIAS-881-430-105] N88-29189
SPACECRAFT SURVIVABILITY
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29381
SPACECRAFT TEMPERATURE
The heat pipe network of TDF-1/TV-SAT. Review of the development at completion
[SNIAS-881-440-103] N88-29127
Reasoning about fault diagnosis for the space station common module thermal control system N88-29395
SPACECREWS
An expert system for a distributed real-time trainer N88-29411
SPACELAB
Experiment scheduling for Spacelab missions N88-29404
SPALLATION
Spallation and dynamic fracture as an effect of laser induced shock-waves
[AD-A193513] N88-28971
SPARE PARTS
Computers in weapons systems: A look at the F-15
[AD-A194498] N88-28920
SPATIAL DISTRIBUTION
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation
[AD-A193958] N88-29068
HPM (High-Power Microwave) coupling into realistic targets
[DE88-011788] N88-29084
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266
SPATIAL FILTERING
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
SPATIAL RESOLUTION
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
SPECIFICATIONS
High hot-hardness gear lubricant evaluations, phase 2
[AD-A192309] N88-29017
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335
SPECKLE INTERFEROMETRY
An upper limit on the primordial He4 abundance from speckle interferometric observations of muon Cassiopeiae N88-29641
SPECTRA
Qualitative characteristics of open waveguide resonator spectra
[DE88-702387] N88-29056
SPECTRAL BANDS
Spectral characteristics and the extent of paleosols of the Palouse formation
[NASA-CR-180947] N88-29210
SPECTRAL SIGNATURES
Mars: Spectral signatures seen and unseen N88-29659
Variability in spectral signatures of terrestrial volcanic rocks and implications for volcanology on Mars N88-29672
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683
SPECTROMETERS
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141
SPECTROSCOPIC ANALYSIS
Applications of charge transfer devices in spectroscopy
[AD-A194408] N88-28992
SPECTROSCOPY
Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum hydroxide
[NASA-TT-20332] N88-29003
SPECTRUM ANALYSIS
Qualitative characteristics of open waveguide resonator spectra
[DE88-702387] N88-29056
Large aperture multi-dimensional laser radar testbed
[AD-A193447] N88-29155
Surface composition of Mars: A Viking multispectral view N88-29655
SPEECH RECOGNITION
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058
Effect of hypoxia on speech recognition in noise
[AD-A193943] N88-29280
Hidden Markov models for automatic speech recognition: Theory and application
[RSRE-MEMO-4135] N88-29350
SPEED CONTROL
Reduction in mill air compressor power requirements through installation of a variable frequency speed control
[DE88-006493] N88-29171
SPHERES
Elastic behavior of a rubber layer bonded between two rigid spheres
[AD-A193698] N88-29030
Effects on the resonant frequencies caused by loading a spherical cavity with a dielectric sphere
[AD-A193864] N88-29511
SPHERICAL TANKS
Orbital Propulsion Module (OPM). Study on coni-spherical surface tension tanks (COSTA)
[MBB-URV-170/87] N88-28963
SPIN DYNAMICS
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624
Resonant spin-flavor precession of solar and supernova neutrinos
[DE88-752604] N88-29707
SPIN-LATTICE RELAXATION
Nuclear magnetic ordering and paramagnetic relaxation of diatomic molecules in Ca (OH)2
[B8681469] N88-29532
Static and dynamic behavior of a quasi one-dimensional Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a He3-He4 dilution refrigerator
[B8705564] N88-29533
Fluctuation and relaxation phenomena studied by means of nuclear orientation
[B8679671] N88-29534
SPREAD SPECTRUM TRANSMISSION
Coding for meteor-burst communications channel and side information for channels with block-interference N88-29054
SPRINGS (ELASTIC)
Leaf spring
[GB-PATENT-2-192-689-A] N88-29179
SPUTTERING
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583
SQUARE WAVES
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193528] N88-29065
SQUID (DETECTORS)
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
Planar thin film SQUID with integral flux concentrator
[NASA-CASE-MFS-28282-1] N88-29602
STABILITY
Unstable heat pipes
[DE88-010780] N88-29217
Stability of semidiscrete approximations for hyperbolic initial-boundary-value problems: Stationary modes
[NASA-TM-100994] N88-29455
Stability experimental results of cable-in-conduit superconductor for fusion
[DE88-753424] N88-29589
STABILIZATION
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r
[AD-A193510] N88-29506

STAINLESS STEELS
Method of forming dynamic membrane on stainless steel support
[NASA-CASE-MSC-18172-3] N88-29052
STANDARDIZATION
Characterization of lubricants in terms of transition diagram data
[AD-A194264] N88-29025
STANDARDS
High hot-hardness gear lubricant evaluations, phase 2
[AD-A192309] N88-29017
Vision and visual protection in fast jet aircraft N88-29292
Ada (trade name) compiler validation summary report: Verdix Corporation VAda-010-03205, version 5.42 MicroVAX 2 host and national DB32000 (NS32032 target
[AD-A193485] N88-29326
STAR CLUSTERS
Clustering of galaxies and clusters of galaxies in a decaying-particle cosmological model with a massive decay product
[DE88-753434] N88-29642
STARTING
Arcjet power supply and start circuit
[NASA-CASE-LEW-14374-1] N88-28939
STATIC FRICTION
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176
STATIC LOADS
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176
STATIONKEEPING
On the collision hazard of colocated geostationary satellites
[DFVLR-FB-88-02] N88-28952
STATISTICAL ANALYSIS
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247
A minitab macro for the Kaplan-Meier product limit estimator and the Tarone-Ware class of tests
[AD-A194296] N88-29331
Multi-sensory tracking mount control
[AD-A194675] N88-29339
Commentary on Harold Hotelling's articles on the teaching of statistics
[AD-A194215] N88-29484
Limiting distributions of non-linear vector functions of stationary Gaussian processes
[AD-A194560] N88-29486
Asymptotic modal analysis and statistical energy analysis
[NASA-CR-183077] N88-29514
STATISTICAL DISTRIBUTIONS
Additional investigations into the aircraft landing process: Test distributions
[ESA-TT-1099] N88-28913
Selecting the best binomial population: Parametric empirical Bayes approach
[AD-A193341] N88-29450
Sequential approach to Colombeau's theory of generalized functions
[DE88-701869] N88-29503
STATISTICAL TESTS
A minitab macro for the Kaplan-Meier product limit estimator and the Tarone-Ware class of tests
[AD-A194296] N88-29331
A nonparametric multidimensional IFIT approach with applications to ability estimation and test bias
[AD-A194212] N88-29483
Exact lower confidence limits for the reliability of k of n systems for zero failures and nonconservativeness of the maximus method
[AD-A194299] N88-29485
STATORS
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
STEADY FLOW
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110
STEADY STATE
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179886] N88-29480
STEELS
Method and apparatus for non-destructive testing of temper embrittlement in steels
[NASA-CASE-LAR-13817-1] N88-29012
High hot-hardness gear lubricant evaluations, phase 2
[AD-A192309] N88-29017
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
STELLAR ACTIVITY
Activity-rotation relations for lower main sequence stars N88-29640
STELLAR ROTATION
Activity-rotation relations for lower main sequence stars N88-29640
STEP FUNCTIONS
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061
STEREOPHOTOGRAPHY
Determining vehicle motion from stereo image sequences
[AD-A194371] N88-29140
STIFFNESS MATRIX
Improved finite strip Mindlin plate bending element using assumed shear strain distributions
[NASA-TM-100928] N88-29195
STOCHASTIC PROCESSES
Dynamic analysis of computer and communications sytems: Semi-Markov approach N88-29305
Weak solution of the Langevin equation on a generalized functional space
[AD-A194290] N88-29456
An asymptotic evaluation of the tail of a multiple symmetric alpha-stable integral
[AD-A194570] N88-29480
On Wiener-Masani's algorithm for finding the generating function of multivariate stochastic processes
[NASA-CR-182905] N88-29481
Stochastic game approach to guidance design
[AD-A194574] N88-29498
STOMACH
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29281
STORAGE BATTERIES
Considerations and measurements of latent-heat-storage salts for secondary thermal battery applications
[DE88-011091] N88-29213
STOWAGE (ONBOARD EQUIPMENT)
Expandable pallet for space station interface attachments
[NASA-CASE-MSC-21117-1] N88-28958
STRAIN RATE
Plastic flow and failure modeling under high strain rate loading
[AD-A194223] N88-29199
STRATEGY
Defensive platform size and survivability
[DE88-011634] N88-28948
STRATIGRAPHY
Stratigraphy of the Kasei Valles region, Mars N88-29690
Documenting volcano-tectonic episodes in Mars' stratigraphic record N88-29695
Ridged and gullied terrains in the Martian uplands N88-29700
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701
STRATOSPHERE
Ultraviolet absorption cross sections of chloro- and chlorofluoromethanes at stratospheric temperatures
[AERONOMICA-ACTA-A-324-1988] N88-29228
Present state of knowledge of the upper atmosphere 1988: An assessment report
[NASA-RP-1208] N88-29233
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987
[NASA-RP-1209] N88-29234
STRESS (PHYSIOLOGY)
Hierarchical structure in polymeric solids and its influence on properties
[AD-A194720] N88-29029
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268
Visual related accidents/incidents N88-29293
Nutrient requirements for high stress environments
[AD-A194595] N88-29301
STRESS (PSYCHOLOGY)
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training
[AD-A194777] N88-29274
Nutrient requirements for high stress environments
[AD-A194595] N88-29301
STRESS ANALYSIS
Structural dynamics of maneuvering aircraft
[AD-A192376] N88-28908
Thin film-residual stress assessment
[AD-A193205] N88-29018
STRESS CONCENTRATION
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-28998
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs
[AD-A193462] N88-29080
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577
STRESS CORROSION
Phenomena of the ionic transport in the stress corrosion of metals
[DE88-702502] N88-29013
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
STRESS DISTRIBUTION
Mechanics of thrust fault formation N88-29229
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577
STRESS INTENSITY FACTORS
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193
Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels
[DE88-701619] N88-29198
STRESS RELAXATION
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
STRESS-STRAIN RELATIONSHIPS
Relation between strength, creep and relaxation behavior in Cu and Al at room temperature
[ETN-88-92982] N88-29015
Plastic flow and failure modeling under high strain rate loading
[AD-A194223] N88-29199
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577
STRING THEORY
Open bosonic string in background electromagnetic field
[DE88-702140] N88-29053
Holomorphic geometry of interacting string
[DE88-702714] N88-29627
The Hilbert space of the open bosonic string
[USIP-88-02] N88-29626
STRUCTURAL ANALYSIS
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193768] N88-29011
Nondestructive investigations for space use
[SNIAS-881-430-105] N88-29189
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204
STRUCTURAL DESIGN
Missiles, fuselages and similar bodies N88-28869
STRUCTURAL DESIGN CRITERIA
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28928
STRUCTURAL PROPERTIES (GEOLOGY)
The Martian sedimentary record N88-29669
Photogeological inferences of Martian surface composition N88-29675
Some probable characteristics of the Martian regolith N88-29678

Surface units on Mars: The assemblage in the Valles Marineris N88-29680
Stratigraphy of the Kasei Valles region, Mars N88-29690

STRUCTURAL STABILITY
Stability control of leakage flow channels [DE88-009995] N88-29107

STRUCTURAL VIBRATION
Nonlinear vibrations of imperfect thin walled cylindrical shells [ETN-88-92904] N88-29205
ASKA-acoustics: Theory and applications --- vibro acoustics [FFA-TN-1988-13] N88-29519

SUBMERGING
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid [AD-A193594] N88-29088

SUBMILLIMETER WAVES
Apparatus for submillimeter laser diagnostics of high-temperature plasma [DE88-702464] N88-29563

SUBSONIC FLOW
Navier-Stokes calculations of transonic flows past cavities [NASA-CR-180484] N88-29116

SUBSTRATES
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition [AD-A193497] N88-28986
Planarization of metal substrates for solar mirrors [DE88-011492] N88-29214

SUCTION
Method for maintaining precise suction strip porosities [NASA-CASE-LAR-13638-1] N88-29051

SULFIDES
Weathering of sulfides on Mars N88-29662

SULFONIC ACID
Molecular composites processing and properties, 1 [AD-A194113] N88-28974

SULFUR DIOXIDES
Episodic vs. epochal release of SO2 on Mars N88-29688

SULFURIC ACID
Kinetic of martensitic transformations induced by hydrogen in the austenite [DE88-701623] N88-29007

SUPERCONDUCTING MAGNETS
High-T(sub c) superconductor and its use in superconducting magnets [DE88-008403] N88-29581

SUPERCONDUCTING POWER TRANSMISSION
Conductor loss in superconducting power transmission cables [DE88-011414] N88-29586

SUPERCONDUCTIVITY
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance [AD-A193815] N88-29143
CryoSQUID: A SQUID-based magnetic field sensor [AD-A194237] N88-29275
Effects of metal substitutions (Fe and Ga) in YBa2Cu3O7 on its superconducting properties and microstructures [DE88-007393] N88-29572
Properties of strong coupled superconductors [DE88-702050] N88-29574
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems [DE88-702060] N88-29576
Electron microscopy of ceramic superconductors [DE88-008446] N88-29580
High-T(sub c) superconductor and its use in superconducting magnets [DE88-008403] N88-29581
An HVEM study of displacement cascade damage in Nb3Sn at 13 K [DE88-009997] N88-29584
Band electronic structures and crystal packing forces [DE88-010247] N88-29585
Stability experimental results of cable-in-conduit superconductor for fusion [DE88-753424] N88-29589
Development of Nb-Ti multifilamentar superconducting wires [DE88-702324] N88-29592
Study of superconducting properties in some many valley semiconductors [DE88-702325] N88-29593
Planar thin film SQUID with integral flux concentrator [NASA-CASE-MFS-28282-1] N88-29602
Dependence of high critical temperature of ceramic superconductors on the nominal Cu(sup 3+)Cu(sup 2+) ratio [DE88-702734] N88-29611
The thermal conductivity of dirty type 2 superconductors [B8681488] N88-29615

SUPERCONDUCTORS
Properties of strong coupled superconductors [DE88-702050] N88-29574
Electron microscopy of ceramic superconductors [DE88-008446] N88-29580
High-T(sub c) superconductor and its use in superconducting magnets [DE88-008403] N88-29581
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering [DE88-009977] N88-29583
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR [DE88-752611] N88-29588
Phase sensitive amplification with SIS (Superconductor-Insulator-Superconductor) quasiparticle mixers [AD-A194594] N88-29596
Fluctuations of order parameters in the high T(sub c) superconductors [DE88-702549] N88-29603
Anomalous dependence of the thermoelectric power on the temperature in YBaCuO high-T(sub c) superconducting samples [DE88-702682] N88-29605

SUPERFLUIDITY
Stability experimental results of cable-in-conduit superconductor for fusion [DE88-753424] N88-29589

SUPERHEATING
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces [DE88-004686] N88-29006

SUPERLATTICES
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques [DE88-006560] N88-29582
Electronic states in tunneling semiconductor superlattices [DE88-011571] N88-29587

SUPERNOVAE
Resonant spin-flavor precession of solar and supernova neutrinos [DE88-752604] N88-29707

SUPERSONIC FLOW
An integral equation for the linearized unsteady supersonic flow over a wing [AD-A193773] N88-28887
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow [AD-A194479] N88-29162
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow [AD-A194493] N88-29163

SUPPORT SYSTEMS
Inflight rearming [AD-A193564] N88-28909

SUPPORTS
Method of forming dynamic membrane on stainless steel support [NASA-CASE-MSC-18172-3] N88-29052

SURFACE ACOUSTIC WAVE DEVICES
Large aperture multi-dimensional laser radar testbed [AD-A193447] N88-29155
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193
A theoretical and experimental investigation into the use of SAW weighting techniques in optical diffraction gratings [RSRE-MEMO-4128] N88-29549

SURFACE LAYERS
Elastic behavior of a rubber layer bonded between two rigid spheres [AD-A193698] N88-29030

SURFACE PROPERTIES
Techniques for boundary layer tripping and control N88-28863
Measure of hydrogen concentration profile in materials by resonant nuclear reactions [DE88-702599] N88-28999
Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni3Al [DE88-702718] N88-29014
The mechanical behavior of surface modified ceramics [DE88-010564] N88-29022
Liquid thickness gauge [NASA-CASE-LAR-13826-1] N88-29150
Surface properties in electric discharge machining [NASA-TT-20243] N88-29182
Green's function approach to roughening transition of one-dimensional restricted solid on solid model [DE88-702723] N88-29512
Optical emission from surface waves supported in thin metal films N88-29540
Potential induced structural transformations of the Au(100) and Au(111) surfaces [DE88-005446] N88-29571
Theoretical investigation of image states of the hydrogen covered Cu (100) [DE88-702662] N88-29604
System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice [DE88-702688] N88-29606
Morphologic contrasts between Nirgal and Auqakuh Valles, Mars: Evidence of different crustal properties N88-29681
Preliminary analysis of recent 2.2-4.2 micrometers telescopic observations of Elysium, Mars: Implications for crystallinity and hydration state of surface materials N88-29692

SURFACE REACTIONS
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces [DE88-004686] N88-29006

SURFACE TO AIR MISSILES
Future air-to-air training for the RF-4 [AD-A194363] N88-29284

SURFACE WAVES
Optical emission from surface waves supported in thin metal films N88-29540

SURVEILLANCE
Aerodynamics of seeing on large transport aircraft [NASA-CR-183122] N88-28896

SURVEILLANCE RADAR
Fine resolution errors in secondary surveillance radar altitude reporting [RSRE-87019] N88-28906

SURVEYS
Signal processing software for ground penetrating radar, user's manual [AD-A194286] N88-29059
Seismic reflection experiments imaging the physical nature of crustal structures in southern California N88-29235

SUSPENSION SYSTEMS (VEHICLES)
Leaf spring [GB-PATENT-2-192-689-A] N88-29179

SWEPT FORWARD WINGS
High performance forward swept wing aircraft [NASA-CASE-ARC-11636-1] N88-28914

SWITCHES
Pseudospark switches [DE88-702227] N88-29085

SWITCHING
Charge storage and switching phenomena in metal complexes [AD-A193778] N88-28996

SYMBOLIC PROGRAMMING
Computer systems for the representation and manipulation of mathematical knowledge [AD-A193547] N88-29340
AI tools in computer based problem solving N88-29424
MACSYMA program for the painleve test of nonlinear ordinary and partial differential equations [AD-A194293] N88-29458

SYMMETRY
Small scale mixing in the initial region of a jet [AD-A193500] N88-28994

SYNCHRONOUS SATELLITES
On the collision hazard of colocated geostationary satellites [DFVLR-FB-88-02] N88-28952

SYNOPTIC MEASUREMENT
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987 [AD-A193960] N88-29251

SYNTAX
Unification and set-valued functions for functional and logic programming [AD-A193643] N88-29341
Experiments in automatic phrase indexing for document retrieval: A comparison of syntactic and non-syntactic methods N88-29534

SYNTHESIS (CHEMISTRY)
Super hydrides [AD-A193710] N88-28995
Polymerization of azaethylenes (imines) and aza-1,3-dienes: Potential reactive monomers [AD-A194717] N88-29028

Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
Diamond film by hot filament CVD method
[NASA-TT-20335] N88-29618

SYNTHETIC APERTURE RADAR
Effect of phase errors in stepped-frequency radar systems
[AD-A194476] N88-29061

SYSTEM IDENTIFICATION
Estimation of aircraft parameters using filter error methods and extended Kalman filter
[DFVLR-FB-88-15] N88-28911

SYSTEMS ANALYSIS
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems
[AD-A193526] N88-29186
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
Center for opto-electronic systems research instrumentation grant
[AD-A193711] N88-29545

SYSTEMS ENGINEERING
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Computer aided filter design
[AD-A193959] N88-29093
A proof of the Kahn principle for input/output automata
[AD-A194454] N88-29333
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335
Computer systems for the representation and manipulation of mathematical knowledge
[AD-A193547] N88-29340
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-86-62] N88-29352
Artificial intelligence applied to process signal analysis N88-29359
On recognizing ignorance N88-29372
Strategic defense initiative architecture dataflow modeling technique version 1.5
[AD-A194356] N88-29494
Dynamically reconfigurable distributed database systems
[AD-A194716] N88-29636

SYSTEMS INTEGRATION
A relational data-knowledge base system and its potential in developing a distributed data-knowledge system N88-29353
Coupling expert systems and simulation N88-29360
Intelligent test integration system N88-29371
Requirements for a tool to aid in the development of expert systems for space station applications N88-29398
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413

SYSTEMS MANAGEMENT
Life-span knowledge engineering for space operations N88-29401
A nonlinear filtering process diagnostic system for the Space Station N88-29417
Real-time space system control with expert systems N88-29419

SYSTOLIC ARRAYS
Systolic array fault tolerance performance analysis
[AD-A193521] N88-29306
Adaptive identification by systolic arrays
[AD-A193532] N88-29444

T

TANKS (COMBAT VEHICLES)
Advanced development waste processing unit for combat vehicles, phase 2
[AD-A193793] N88-29302

TARGET ACQUISITION
Interactive, networked moving platform simulators
[AD-A192374] N88-28940
Evaluation of atmospheric effects for operational tactical decision aid
[AD-A194205] N88-29236

TARGET RECOGNITION
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487

TARGETS
HPM (High-Power Microwave) coupling into realistic targets
[DE88-011788] N88-29084
Multi-sensory tracking mount control
[AD-A194675] N88-29339

TDR SATELLITES
NOA: A Network Operator Assistant for scheduling Tracking and Data Relay Satellite System (TDRSS) N88-29403

TECHNICAL WRITING
Technical communication in the computer industry: An information-development process to track, measure and ensure quality N88-29635

TECHNOLOGY ASSESSMENT
Recent advances in high-power microwave amplifiers
[DE88-007820] N88-29083
Reliability assessment of Surface Mount Technology (SMT)
[AD-A193759] N88-29089
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177

TECHNOLOGY TRANSFER
Argonne National Laboratory technology transfer report, FY87
[DE88-010091] N88-29639

TECTONICS
Documenting volcano-tectonic episodes in Mars' stratigraphic record N88-29695

TELECOMMUNICATION
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079

TELEMETRY
Multi-sensory tracking mount control
[AD-A194675] N88-29339
An expert systems application to space base data processing N88-29384
Long haul underwater fiber optic link
[AD-A194487] N88-29542

TELEOPERATORS
Concepts for robot motion primitives required for space station teleoperations N88-29387
A teleoperated robotic manipulator system for materials processing experiment servicing N88-29410

TELESCOPES
Martian surface analogs: Laboratory spectral studies in the mid infrared N88-29699
Very high energy cosmic gamma rays from radio and X-ray pulsars N88-29711

TELEVISION SYSTEMS
High definition television: Evaluation for remote task performance
[DE88-011573] N88-29057

TELLURIUM
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600

TEMPERATURE
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487

TEMPERATURE CONTROL
The heat pipe network of TDF-1/TV-SAT. Review of the development at completion
[SNIAS-881-440-103] N88-29127
Testing degradation of a sample under thermal cycling
[GB-PATENT-2-188-163-A] N88-29206
Reasoning about fault diagnosis for the space station common module thermal control system N88-29395

TEMPERATURE DEPENDENCE
Properties of strong coupled superconductors
[DE88-702050] N88-29574
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques
[DE88-008560] N88-29582
Anomalous dependence of the thermoelectric power on the temperature in YBaCuO high-T(sub c) superconducting samples
[DE88-702682] N88-29605
Influence of the temperature-dependence of recombination life-time of free carriers in amorphous semiconductors on thermostimulated photocurrent spectra
[DE88-702728] N88-29609
Thermostimulated conductivity in amorphous semiconductors with non-exponential density of localized states
[DE88-702737] N88-29612

TEMPERATURE DISTRIBUTION
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268
Reasoning about fault diagnosis for the space station common module thermal control system N88-29395

TEMPERATURE EFFECTS
Ultraviolet absorption cross sections of chloro- and chlorofluoromethanes at stratospheric temperatures
[AERONOMICA-ACTA-A-324-1988] N88-29228
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
Thermodynamical, optical and X-rays studies of some thermotropic liquid crystals
[DE88-702301] N88-29590
Temperature dependence of conductivity and of Hall coefficients for noble metal films
[ETN-88-92981] N88-29616

TEMPORAL DISTRIBUTION
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation
[AD-A193958] N88-29068

TENSILE STRENGTH
A technique for measuring area under a curve
[AD-A193559] N88-29463

TENSORS
On nonlinear equations admitting soliton solutions with a deBroglie phase
[DE88-702694] N88-29508
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551

TERRAIN
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684
Ridged and gullied terrains in the Martian uplands N88-29700

TERRAIN ANALYSIS
Motion planning for legged locomotion systems on uneven terrain N88-29170

TEST FACILITIES
Unsteady water channel
[AD-A194231] N88-28884
Lewis Research Center space station electric power system test facilities
[NASA-TM-100924] N88-28942
Testing degradation of a sample under thermal cycling
[GB-PATENT-2-188-163-A] N88-29206

TEST STANDS
Beam optics test stand
[AD-A193901] N88-29144

TETHERED SATELLITES
Analytical investigation of the dynamics of tethered constellations in earth orbit
[NASA-CR-179371] N88-28950

TETHERING
Study of Plasma Motor Generator (PMG) tether system for orbit reboost
[NASA-CR-172074] N88-28949
Analytical investigation of the dynamics of tethered constellations in earth orbit
[NASA-CR-179371] N88-28950

THEMATIC MAPPING
Spectral characteristics and the extent of paleosols of the Palouse formation
[NASA-CR-180947] N88-29210

THEORETICAL PHYSICS
Evidence for laser emission from the TICT exciplex of coumarin dyes
[DE88-702544] N88-29167
Weak interaction physics: From its birth to the electroweak model
[DE88-702494] N88-29531
Theoretical studies in high energy physics
[DE88-011606] N88-29538
Theoretical particle physics
[DE88-011499] N88-29621
Time travel in the homogeneous Som-Raychaudhuri universe
[DE88-702220] N88-29622
Holomorphic geometry of interacting string
[DE88-702714] N88-29627

THERMAL ANALYSIS
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28960
Adaptive computational methods for aerothermal heating analysis
[NASA-CR-181636] N88-29115
Free electron lasers with small period wigglers
[DE88-011627] N88-29156
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222

An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539
THERMAL BATTERIES
Considerations and measurements of latent-heat-storage salts for secondary thermal battery applications
[DE88-011091] N88-29213
THERMAL CONDUCTIVITY
The thermal conductivity of dirty type 2 superconductors
[B8681488] N88-29615
Viking Landers and remote sensing N88-29685
THERMAL CYCLING TESTS
Testing degradation of a sample under thermal cycling
[GB-PATENT-2-188-163-A] N88-29206
THERMAL DEGRADATION
Testing degradation of a sample under thermal cycling
[GB-PATENT-2-188-163-A] N88-29206
THERMAL EMISSION
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
THERMAL EXPANSION
Thin film-residual stress assessment
[AD-A193205] N88-29018
High effectiveness contour matching contact heat exchanger
[NASA-CASE-MSC-20840-1] N88-29132
THERMAL INSULATION
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
THERMAL STABILITY
Reaction-theoretical aspects of the thermal behavior of lubricating oils and working fluids
[NASA-TT-20304] N88-29041
THERMAL STRESSES
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
Thin film-residual stress assessment
[AD-A193205] N88-29018
THERMIONIC CONVERTERS
Liquid metal thermal-electric converter electrode development
[DE88-009252] N88-29221
THERMOCHEMISTRY
Theoretical investigations of nitrocubane decomposition
[AD-A194556] N88-29047
Chemical interactions between the present-day Martian atmosphere and surface minerals N88-29689
THERMOCHROMATIC MATERIALS
Quasi-liquid crystalline materials with special electro-optic properties
[AD-A194579] N88-29544
THERMOCOUPLES
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151
THERMODYNAMICS
Thermodynamic data bases for multivalent elements: An example for ruthenium
[DE88-004395] N88-28984
The construction of the thermoelasticity equations on the basis of contemporary notions of nonlinear continua mechanics
[NASA-TT-20307] N88-29631
THERMOELASTICITY
The construction of the thermoelasticity equations on the basis of contemporary notions of nonlinear continua mechanics
[NASA-TT-20307] N88-29631
THERMOELECTRICITY
Anomalous dependence of the thermoelectric power on the temperature in YBaCuO high-T(sub c) superconducting samples
[DE88-702682] N88-29605
THERMOGRAPHY
Improvements in techniques of microwave thermography
[AD-A194613] N88-29062
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
THERMOPLASTIC RESINS
An investigation of some basic properties of hybrid composite materials
[AD-A194136] N88-28975
THERMOSPHERE
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240
THICKNESS
Ice detector
[NASA-CASE-LAR-13776-1] N88-29149
Liquid thickness gauge
[NASA-CASE-LAR-13826-1] N88-29150
Thickness effects on the stability of shell like structures N88-29192
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701
THIN AIRFOILS
Technology for pressure-instrumented thin airfoil models
[NASA-CR-4173] N88-28933
THIN FILMS
Thin film coatings for space electrical power system applications
[NASA-TM-101325] N88-28966
Thin film-residual stress assessment
[AD-A193205] N88-29018
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027
Theoretical investigation on heterojunction solar cell
[DE88-701837] N88-29219
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583
Research on crystal and film ferroelectric materials for optoelectronic applications
[AD-A193512] N88-29597
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598
New method for preparation of (Cd, Hg)Te thin films
[DE88-702727] N88-29606
Temperature dependence of conductivity and of Hall coefficients for noble metal films
[ETN-88-92981] N88-29616
Diamond film by hot filament CVD method
[NASA-TT-20335] N88-29618
THIN WALLED SHELLS
Nonlinear vibrations of imperfect thin walled cylindrical shells
[ETN-88-92904] N88-29205
THIOLS
Correlations between wettability and structure in monolayers of alkanethiols adsorbed on gold
[AD-A194348] N88-28991
THREE AXIS STABILIZATION
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240
THREE DIMENSIONAL BOUNDARY LAYER
Study of hypersonic boundary layers
[CERT-RSF-OA-17/5005-AYD] N88-29121
THREE DIMENSIONAL COMPOSITES
An investigation of some basic properties of hybrid composite materials
[AD-A194136] N88-28975
THREE DIMENSIONAL FLOW
Shock boundary layer interaction N88-28873
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-180484] N88-29116
Study of hypersonic boundary layers
[CERT-RSF-OA-17/5005-AYD] N88-29121
Experience with three dimensional composite grids N88-29324
THREE DIMENSIONAL MOTION
Determining vehicle motion from stereo image sequences
[AD-A194371] N88-29140
THRESHOLD VOLTAGE
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs
[AD-A193462] N88-29080
THUNDERSTORMS
Investigations into the triggered lightning response of the F106B thunderstorm research aircraft
[NASA-CR-3902] N88-29258
THYRATRONS
Linear thyratron
[AD-A194111] N88-29094
TIME
A numerical study of the test time in a hypersonic shock tunnel
[AD-A194057] N88-28888
A linear-time algorithm for finding a minimum spanning pseudoforest
[AD-A194029] N88-29346
Improved time bounds for the maximum flow problem
[AD-A194034] N88-29471
Time travel in the homogeneous Som-Raychaudhuri universe
[DE88-702220] N88-29622
TIME DEPENDENCE
The calculation of time dependent eddy currents in tokamaks
[REPT-206] N88-29568
Chaotic behaviour in quantum dynamics
[AD-A193936] N88-29623
TIME LAG
Concepts for robot motion primitives required for space station teleoperations N88-29387
TIME SERIES ANALYSIS
Atmospheric angular momentum and length of day
[AD-A194505] N88-29238
TIME SHARING
The emergence of multi-user expert systems N88-29406
Networking and AI systems: Requirements and benefits N88-29425
TIN ALLOYS
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
TISSUES (BIOLOGY)
Improvements in techniques of microwave thermography
[AD-A194613] N88-29062
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
TITANIUM
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137
TITANIUM ALLOYS
Investigation of a SiC/Ti-24Al-11Nb composite
[NASA-TM-100956] N88-28980
Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V
[DE88-006458] N88-29197
Development of Nb-Ti multifilamentar superconducting wires
[DE88-702324] N88-29592
TITANIUM OXIDES
Al2O3-TiO2 and Al2TiO5 ceramic materials
[SNIAS-881-430-122] N88-29038
TOKAMAK DEVICES
A survey of the current experimental database for lower hybrid current-drive and heating
[DE88-009830] N88-29552
Numerical simulations of resistive magnetohydrodynamic instabilities in a poloidal divertor tokamak
[DE88-010788] N88-29559
Bootstrap currents in radio-frequency-driven tokamak equilibria
[DE88-011136] N88-29561
Tokamak plasma interaction with limiters
[UTIAS-325] N88-29566
The calculation of time dependent eddy currents in tokamaks
[REPT-206] N88-29568
Stability experimental results of cable-in-conduit superconductor for fusion
[DE88-753424] N88-29589
TOLERANCES (MECHANICS)
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-28968
TOLLMEIN-SCHLICHTING WAVES
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task
[NASA-CR-3992] N88-28894
TOMOGRAPHY
Variation of carotid flow under load, studied by the Doppler echo method --- acceleration tolerance
[REPT-1149] N88-29282
TOPOGRAPHY
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658
Topography of large craters on Mars: Implications for the highlands resurfacing history N88-29691

TOPOLOGY
Optimization-driven machine-oriented motion measurement N88-29312
Monotone recurrence relations, their Birkhoff orbits and topological entropy
[AD-A193481] N88-29504
TOROIDAL PLASMAS
Density fluctuations in currentless high beta plasmas in Heliotron E
[DE88-752310] N88-29550
TORQUE MOTORS
Study on design and control of torque-controlled manipulators
[NASA-TT-20197] N88-29183
TORUSES
Unfoldings of quasi-periodic tori
[88811118] N88-29513
TOUGHNESS
A technique for measuring area under a curve
[AD-A193559] N88-29483
TRACE ELEMENTS
The 1985-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226
TRACKING (POSITION)
Interactive, networked moving platform simulators
[AD-A192374] N88-28940
The gradient method for interface tracking
[AD-A194477] N88-29334
Multi-sensory tracking mount control
[AD-A194675] N88-29339
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation
[AD-A193746] N88-29499
TRACKING FILTERS
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487
TRAFFIC CONTROL
Airport surface traffic automation study
[AD-A194553] N88-28934
TRAILING EDGES
Classical separation, trailing-edge flows and buffeting N88-28874
Experiments on the dissipation of sound by separated flow at an edge
[ISVR-TR-151] N88-29522
TRAINING EVALUATION
An expert system for a distributed real-time trainer N88-29411
TRAJECTORY CONTROL
Time minimal computation of feedback control schemes for optimal guidance problems used in space flight
[ETN-88-92989] N88-28953
TRANSFERRING
USAF hyperbaric animal transfer chamber system
[AD-A193633] N88-29265
TRANSIENT RESPONSE
Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179886] N88-29480
TRANSISTORS
Evaluation of silicon-on-insulator MOS (Metal-Oxide-Semiconductor) transistor response to 10-keV X-ray and cobalt-60 irradiation
[DE88-006102] N88-29082
Metal grid base heterojunction transistor operating at 60 and 94 GHz
[AD-A194763] N88-29087
TRANSITION POINTS
Characterization of lubricants in terms of transition diagram data
[AD-A194264] N88-29025
TRANSITION TEMPERATURE
High-T(sub c) superconductor and its use in superconducting magnets
[DE88-008403] N88-29581
Thermodynamical, optical and X-rays studies of some thermotropic liquid crystals
[DE88-702301] N88-29590
Fluctuations of order parameters in the high T(sub c) superconductors
[DE88-702549] N88-29603
Dependence of high critical temperature of ceramic superconductors on the nominal Cu(sup 3+)Cu(sup 2+) ratio
[DE88-702734] N88-29611
TRANSMITTANCE
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3
[AD-A194670] N88-29239
TRANSONIC FLOW
Boundary layer development and transition N88-28871
The influence of numerical boundary conditions on transonic flow
[DFVLR-FB-88-06] N88-28890
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-180484] N88-29116
Three-dimensional elliptic grid generation for an F-16 N88-29315
TRANSONIC SPEED
Test results at transonic speeds on a contoured over-the-wing propfan model
[NASA-TM-88206] N88-28918
TRANSONIC WIND TUNNELS
Boundary layer simulation and control in wind tunnels
[AGARD-AR-224] N88-28857
TRANSPARENCE
Vision through aircraft transparencies N88-29294
Maintenance of vision-related components N88-29296
TRANSPORT AIRCRAFT
Critical joints in large composite primary aircraft structures. Volume 1: Technical summary
[NASA-CR-3914] N88-28983
TRANSPORT PROPERTIES
Phenomena of the ionic transport in the stress corrosion of metals
[DE88-702502] N88-29013
Transport of organic vapors in multiphase polymer system
[AD-A194097] N88-29033
TRANSPORT THEORY
Introduction to laser plasma diagnostics
[DE88-011056] N88-29560
Bootstrap currents in radio-frequency-driven tokamak equilibria
[DE88-011136] N88-29561
TRAPPED PARTICLES
Large area nuclear particle detectors using ET materials
[NASA-CR-180777] N88-29136
TRAVELING WAVE AMPLIFIERS
Wide band gyrotron traveling wave amplifier analysis
[AD-A194269] N88-29139
TRIGGER CIRCUITS
Pseudospark switches
[DE88-702227] N88-29085
TROPOSPHERE
Atmospheric deposition of nitrate to the ocean surface N88-29227
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987
[NASA-RP-1209] N88-29234
TRUSSES
Collet lock joint for space station truss
[NASA-CASE-MSC-21207-1] N88-29180
TUBE HEAT EXCHANGERS
Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants
[DE88-701821] N88-29174
TUNABLE LASERS
The 1985-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226
TUNGSTEN
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986
TURBINE BLADES
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
Dynamic response of a 330-kW horizontal axis wind turbine generator
[DE88-001136] N88-29212
TURBINE PUMPS
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184
TURBINES
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
TURBOCOMPRESSORS
Modeling of large stall in axial compressors
[VKI-NT-164] N88-29124
TURBOFAN AIRCRAFT
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS)
[NASA-CR-175104] N88-28917
TURBOPROP AIRCRAFT
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS)
[NASA-CR-175104] N88-28917
TURBOPROP ENGINES
Experimental and analytical evaluation of the effects of simulated engine inlets on the blade vibratory stresses of the SR-3 model prop-fan
[NASA-CR-174959] N88-28927
TURBULENCE
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28898
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
TURBULENT BOUNDARY LAYER
Development and analysis of turbulent non-equilibrium boundary layers N88-28872
Environmental effects on transition and boundary layer characteristics N88-28876
Stability and drag reduction in a boundary layer with microbubbles
[AD-A191975] N88-29099
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence
[FFA-TN-1988-02] N88-29126
TURBULENT FLOW
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994
Three-dimensional laser Doppler velocimeter studies of flow in a 90 deg curved duct having a square cross-section N88-29101
A numerical study of turbulent plane jets in still and flowing environments employing two-equation k-epsilon model N88-29109
Modeling of momentum transport of axially parallel turbulent flows in rod cascades
[ETN-88-92978] N88-29131
TURBULENT WAKES
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936
TWENTY-SEVEN DAY VARIATION
Short term variability between 120 and 300 mm from Solar Mesosphere Explorer (SME) observations
[AERONOMICA-ACTA-A-328-1988] N88-29709
TWO PHASE FLOW
Two phase flow in a rotating screw tube (screw tube pump). Investigation of the function and efficiency of the screw tube pump
[MPIS-16/1987] N88-29178

U

U.S.S.R. SPACE PROGRAM
The Soviet MIR space station
[AD-A194040] N88-28951
ULTRASONICS
Combustion studies of acoustically suspended liquid droplets
[AD-A193892] N88-28998
An investigation of acoustic cavitation produced by pulsed ultrasound
[AD-A193523] N88-29516
ULTRAVIOLET ABSORPTION
Ultraviolet absorption cross sections of chloro- and chlorofluoromethanes at stratospheric temperatures
[AERONOMICA-ACTA-A-324-1988] N88-29228
ULTRAVIOLET SPECTROSCOPY
Applications of charge transfer devices in spectroscopy
[AD-A194408] N88-28992
High performance charge transfer device detectors
[AD-A194409] N88-28993
UNDERGROUND STRUCTURES
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
UNDERWATER ACOUSTICS
Polynomials with restricted coefficients and their applications
[AD-A192589] N88-29055
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518

UNDERWATER COMMUNICATION
Long haul underwater fiber optic link
[AD-A194487] N88-29542
UNDERWATER VEHICLES
Estimation forces acting on an underwater vehicle with G.P.S. (Global Positioning System) and Kalman filtering
[AD-A194339] N88-28901
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177
UNIVERSE
Time travel in the homogeneous Som-Raychaudhuri universe
[DE88-702220] N88-29622
Non-linear scale invariance in a cold-dark-matter universe
[DE88-011725] N88-29644
UNSTEADY AERODYNAMICS
An unsteady helicopter rotor: Fuselage interaction analysis
[NASA-CR-4178] N88-28880
Accurate solutions, parameter studies and comparisons for the Euler and potential flow equations
[NASA-TM-100664] N88-28892
UNSTEADY FLOW
An unsteady helicopter rotor: Fuselage interaction analysis
[NASA-CR-4178] N88-28880
Unsteady water channel
[AD-A194231] N88-28884
Unsteady flow past an NACA 0012 airfoil at high angles of attack
[AD-A194650] N88-28886
An integral equation for the linearized unsteady supersonic flow over a wing
[AD-A193773] N88-28887
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114
Shock waves in unsteady flows
[NASA-TT-20329] N88-29134
UPLINKING
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077
UPPER ATMOSPHERE
Present state of knowledge of the upper atmosphere 1988: An assessment report
[NASA-RP-1208] N88-29233
USER MANUALS (COMPUTER PROGRAMS)
Finite Element Composite Analysis Program (FECAP) for a microcomputer
[NASA-TM-100670] N88-28982
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
Level 1 Ada/SQL (Structured Query Language) database language interface user's guide
[AD-A194480] N88-29335
USER REQUIREMENTS
ADP (Automated Data Processing) requirements definition and documentation through user-developed prototypes
[AD-A194407] N88-29332
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems
[AD-A193560] N88-29484
Central user and browse service — ERS-1 ground segment
[CU-PG-MDA-SY-0005] N88-29637

V

VACUUM
Measurements of vacuum arc ion charge state distributions
[DE88-008249] N88-29558
VALLEYS
Intercrater plains deposits and the origin of Martian valleys N88-29661
VAPOR DEPOSITION
Ultrafine microstructure composites prepared by chemical vapor deposition
[AD-A193849] N88-28973
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986
Metal grid base heterojunction transistor operating at 60 and 94 GHz
[AD-A194763] N88-29087
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595
Diamond film by hot filament CVD method
[NASA-TT-20335] N88-29618
VAPOR PHASES
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193681] N88-28997
VAPORS
Transport of organic vapors in multiphase polymer system
[AD-A194097] N88-29033
VARIABLE SWEEP WINGS
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task
[NASA-CR-3992] N88-28894
Variable wing camber control systems for the future Airbus program
[MBB-UT-104/88] N88-28932
VARIATIONS
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120
Mathematical correlation between variations in solar radiation parameters. Part 1: Daily sums of global radiation and midday global radiation
[DE88-702742] N88-29253
Improved time bounds for the maximum flow problem
[AD-A194034] N88-29471
Fluctuations of order parameters in the high T(sub c) superconductors
[DE88-702549] N88-29603
VECTOR ANALYSIS
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487
Limiting distributions of non-linear vector functions of stationary Gaussian processes
[AD-A194569] N88-29488
VECTOR SPACES
Cosmology in an N-dimensional vector space
[DE88-702550] N88-29507
VELOCITY
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487
VELOCITY DISTRIBUTION
Rotation symmetric inside flow with diametric expansion resolution
[ILR-MITT-193] N88-29123
Application of Particle Image Displacement Velocimetry (PIDV) to complex flows: Velocity field measurements in front of a heavy gas cloud
[VKI-TN-166] N88-29125
Clustering of galaxies and clusters of galaxies in a decaying-particle cosmological model with a massive decay product
[DE88-753434] N88-29642
VELOCITY MEASUREMENT
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112
Application of Particle Image Displacement Velocimetry (PIDV) to complex flows: Velocity field measurements in front of a heavy gas cloud
[VKI-TN-166] N88-29125
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152
VENTILATION
Model test of air-exchange efficiency
[DE88-752682] N88-29049
VERTICAL DISTRIBUTION
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987
[NASA-RP-1209] N88-29234
VERTICAL ORIENTATION
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120
VIBRATION
Overview of computational vibro acoustics. State of the art and future development
[FFA-TN-1988-17] N88-29521
Vibration spectra induced by impurities in 3-5-compounds semiconductors
[DE88-702730] N88-29610
VIBRATION DAMPING
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites
[UTIAS-324] N88-28970
Passive damping concepts for free and forced member and grillage vibration
[NASA-CR-183114] N88-29196
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
Anti-aliasing filters for dynamics and control experiments
[AD-A193758] N88-29203
VIBRATIONAL SPECTRA
Polymeric electrolytes
[AD-A193766] N88-29031
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
Measurements of XeF (Xenon Fluoride) ground state dissociation and vibrational equilibration
[AD-A194611] N88-29527
VIDEO DATA
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29706
VISCOELASTICITY
Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179886] N88-29480
VISCOSITY
Fellowships in hypersonic aerodynamics
[AD-A194265] N88-28885
A limiting viscosity approach to the Riemann problem for materials exhibiting change of phase
[AD-A193477] N88-29103
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
VISCOUS FLOW
Boundary layer manipulation N88-28877
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-28891
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114
European research program on viscous flows
[DFVLR-AVA-IB-227-87-A-15] N88-29129
VISION
Human performance and acute hypoxia, chapter 12
[AD-A192604] N88-29270
Vision and visual protection in fast jet aircraft N88-29292
Vision through aircraft transparencies N88-29294
VISORS
Vision through aircraft transparencies N88-29294
VISUAL DISCRIMINATION
Limits of pattern discrimination in human vision
[AD-A193449] N88-29273
VISUAL PERCEPTION
Limits of pattern discrimination in human vision
[AD-A193449] N88-29273
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288
Transformations of short-term visual memory
[AD-A193873] N88-29290
Visual Effects in the High Performance Aircraft Cockpit
[AGARD-LS-156] N88-29291
Visual related accidents/incidents N88-29293
VISUAL STIMULI
Human auditory and visual continuous evoked potentials N88-29269
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288
VOICE COMMUNICATION
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058
VOLCANOES
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658
Early cratering rates and the nature of the Martian cratered uplands N88-29694

VOLCANOLOGY
A review: Quantitative models for lava flows on Mars N88-29656
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
Variability in spectral signatures of terrestrial volcanic rocks and implications for volcanology on Mars N88-29672
VOLUME
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
VOMITING
Emetic mechanism in acute radiation sickness [AD-A194102] N88-29267
VORTEX BREAKDOWN
Vortex flows N88-28875
VORTICES
Vortex flows N88-28875
Noise generation and boundary layer effects in vortex-airfoil interaction and methods of digital hologram analysis for these flow fields [AD-A194191] N88-28883
Unsteady flow past an NACA 0012 airfoil at high angles of attack [AD-A194650] N88-28886
Three-dimensional vortex interactions [AD-A194066] N88-28889
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis) [AD-A193580] N88-29117
Construction of a laser Doppler anemometer and its use for the testing of a novel probe for the measurement of the variations of the lateral component of the vortex vector [MPIS-13/1987] N88-29147
Experiments on the dissipation of sound by separated flow at an edge [ISVR-TR-151] N88-29522
Vortex formation and particle transport in a cross-field plasma sheath [DE88-008931] N88-29553
VULNERABILITY
Defensive platform size and survivability [DE88-011634] N88-28948

W

WAFERS
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate [AD-A194713] N88-29027
WAKES
Unsteady flow past an NACA 0012 airfoil at high angles of attack [AD-A194650] N88-28886
WALKING
Gastric emptying during walking and running: Effects of varied exercise intensity [AD-A194025] N88-29281
WALL TEMPERATURE
Plasma theory and simulation [AD-A194674] N88-29565
WARFARE
The principles of mass and maneuver applied to space operations [AD-A194037] N88-29500
WASTE DISPOSAL
Advanced development waste processing unit for combat vehicles, phase 2 [AD-A193793] N88-29302
WASTE ENERGY UTILIZATION
Absorption heat pumps [DE88-752820] N88-29218
WATER
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces [DE88-004686] N88-29006
Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29686
How dirty is Mars' North Polar cap, and why isn't it black N88-29677
Coadsorption of H2O and CO2 on the Martian surface N88-29702
WATER TUNNEL TESTS
Unsteady water channel [AD-A194231] N88-28884
WATER WAVES
A singular perturbation analysis of the weakly nonlinear evolution of long and short water waves and waves in boundary layers N88-29102
WAVE DISPERSION
Elastic wave dispersion in laminated composite plate [AD-A192289] N88-28967
Wide band gyrotron traveling wave amplifier analysis [AD-A194269] N88-29139
Kinetic theory for electrostatic waves due to transverse velocity shears [AD-A193404] N88-29557
WAVE EQUATIONS
The construction of implicit and explicit solitary wave solutions of nonlinear partial differential equations [AD-A193475] N88-29452
Solution of large order Fourier-Bessel equations [ARE-TM(UHA)-88504] N88-29475
WAVE EXCITATION
Three-dimensional vortex interactions [AD-A194066] N88-28889
WAVE FUNCTIONS
Passage of relativistic magnetic dipole moments through magnetic fields [DE88-702640] N88-29624
WAVE INTERACTION
Three-dimensional vortex interactions [AD-A194066] N88-28889
Interactions between synoptic and planetary scales of motion [AD-A192328] N88-29246
On the degenerate Ferrari-Ibanez solution for colliding plane gravitational waves [MATH-REPT-209] N88-29630
WAVE PROPAGATION
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements [AD-A194134] N88-29240
The acoustic field scattered from some approximate pressure release materials [AD-A194768] N88-29515
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551
Plasmoid propagation [AD-A192378] N88-29555
WAVE REFLECTION
Wave and fracture phenomena in impacted ceramics [AD-A192946] N88-29020
WAVEFORMS
Effect of phase errors in stepped-frequency radar systems [AD-A194476] N88-29061
The 1983 direct strike lightning data, part 1 [NASA-TM-86426-PT-1] N88-29259
The 1983 direct strike lightning data, part 2 [NASA-TM-86426-PT-2] N88-29260
The 1983 direct strike lightning data, part 3 [NASA-TM-86426-PT-3] N88-29261
Waveform analysis on the IBM PC [AD-A194249] N88-29330
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise [AD-A193865] N88-29492
WAVEGUIDES
Qualitative characteristics of open waveguide resonator spectra [DE88-702387] N88-29056
WEAK ENERGY INTERACTIONS
Weak interaction physics: From its birth to the electroweak model [DE88-702494] N88-29531
WEAK INTERACTIONS (FIELD THEORY)
Weak interaction physics: From its birth to the electroweak model [DE88-702494] N88-29531
WEAPON SYSTEM MANAGEMENT
Contribution of expert systems to avionics advance. Application on AS30 laser weapon system [SNIAS-881-320-103] N88-29449
WEAPON SYSTEMS
Inflight rearming [AD-A193564] N88-28909
Computers in weapons systems: A look at the F-15 [AD-A194496] N88-28920
WEAR
An investigation of some basic properties of hybrid composite materials [AD-A194136] N88-28975
Static and dynamic metal-metal friction at plastic stress levels [DE88-011281] N88-29176
WEAR RESISTANCE
Development of high temperature, high pressure rotating shaft seals [DE88-001029] N88-29172
WEATHER
Typical weather months in the past (1973-1983) in Central Europe [AD-A194701] N88-29249
Basic causes of amplitude modulation in climatic/weather parameters [DE88-702743] N88-29254
WEATHER FORECASTING
Investigations on the entropy of cloudy air [ESA-TT-1060] N88-29245
Typical weather months in the past (1973-1983) in Central Europe [AD-A194701] N88-29249
WEATHERING
Selective weathering of shocked minerals and chondritic enrichment of the Martian fines N88-29660
Weathering of sulfides on Mars N88-29662
Variability in spectral signatures of terrestrial volcanic rocks and implications for volcanology on Mars N88-29672
Aqueous alteration in S-N-C meteorites and implications for weathering products on Mars N88-29673
Some probable characteristics of the Martian regolith N88-29678
What SNC meteorites tell us about Martian magmatism N88-29679
Preliminary analysis of recent 2.2-4.2 micrometers telescopic observations of Elysium, Mars: Implications for crystallinity and hydration state of surface materials N88-29692
WEAVING
An investigation of some basic properties of hybrid composite materials [AD-A194136] N88-28975
WEDGES
Acoustic pressure distribution on the bottom of a wedge-shaped ocean [AD-A193961] N88-29518
WEIGHTING FUNCTIONS
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise [AD-A193865] N88-29492
A theoretical and experimental investigation into the use of SAW weighting techniques in optical diffraction gratings [RSRE-MEMO-4128] N88-29549
WELDED JOINTS
Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants [DE88-701621] N88-29174
WETTABILITY
Correlations between wettability and structure in monolayers of alkanethiols adsorbed on gold [AD-A194348] N88-28991
WICKS
Polymeric heat pipe wick [NASA-CASE-GSC-13019-1] N88-29133
WIGGLER MAGNETS
Free electron lasers with small period wigglers [DE88-011627] N88-29156
WIGNER COEFFICIENT
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise [AD-A193865] N88-29492
WIND EFFECTS
Effects of precipitation on wind turbine performance [DE88-001144] N88-29211
WIND PROFILES
Wind measurements by electromagnetic probes [NASA-TM-4068] N88-29256
WIND SHEAR
Contributions to the modeling of wind shear for danger studies [NASA-TT-20293] N88-28900
Airborne radar technology for windshear detection [NASA-CR-183203] N88-29257
WIND TUNNEL CALIBRATION
Reynolds number effects and the wind tunnel environment N88-28862
Flow visualization on a small scale [AD-A194728] N88-28935
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel [AD-A194737] N88-28936
WIND TUNNEL MODELS
Techniques for boundary layer tripping and control N88-28863
Experimental tools: The tunnel and the model N88-28864
Computational tools for simulation methodologies N88-28865
Technology for pressure-instrumented thin airfoil models [NASA-CR-4173] N88-28933
WIND TUNNEL TESTS
Missiles, fuselage and similar bodies N88-28858
High-aspect-ratio wings N88-28859
Complex configurations N88-28861
Reynolds number effects and the wind tunnel environment N88-28862
Techniques for boundary layer tripping and control N88-28863

Experimental tools: The tunnel and the model
N88-28864
Empirical tools for simulation methodologies
N88-28866
Introduction and critical flow phenomena N88-28870
Environmental effects on transition and boundary layer characteristics N88-28876
Boundary layer manipulation N88-28877
Effects of independent variation of Mach and Reynolds numbers on the low-speed aerodynamic characteristics of the NACA 0012 airfoil section
[NASA-TM-4074] N88-28879
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881
Aerodynamic data accuracy and quality: Requirements and capabilities in wind tunnel testing
[AGARD-AR-254] N88-28893
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895
Test results at transonic speeds on a contoured over-the-wing propfan model
[NASA-TM-88206] N88-28918
Experimental and analytical evaluation of the effects of simulated engine inlets on the blade vibratory stresses of the SR-3 model prop-fan
[NASA-CR-174959] N88-28927

WIND TURBINES
Effects of precipitation on wind turbine performance
[DE88-001144] N88-29211
Dynamic response of a 330-kW horizontal axis wind turbine generator
[DE88-001136] N88-29212

WIND VARIATIONS
Atmospheric angular momentum and length of day
[AD-A194505] N88-29238

WIND VELOCITY MEASUREMENT
Wind measurements by electromagnetic probes
[NASA-TM-4066] N88-29256

WINDSHIELDS
Vision through aircraft transparencies N88-29294

WING CAMBER
Variable wing camber control systems for the future Airbus program
[MBB-UT-104/88] N88-28932

WING PLANFORMS
An integral equation for the linearized unsteady supersonic flow over a wing
[AD-A193773] N88-28887

WINGS
Transport-type configurations N88-28867
An integral equation for the linearized unsteady supersonic flow over a wing
[AD-A193773] N88-28887
Critical joints in large composite primary aircraft structures. Volume 2: Technology demonstration test report
[NASA-CR-172587] N88-28915
Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results
[NASA-CR-172588] N88-28916
Test results at transonic speeds on a contoured over-the-wing propfan model
[NASA-TM-88206] N88-28918
Development of a glass fiber wing following the construction regulation FAR Part 23
[ETN-88-92966] N88-28979
Critical joints in large composite primary aircraft structures. Volume 1: Technical summary
[NASA-CR-3914] N88-28983

WIRE
Development of Nb-Ti multifilamentar superconducting wires
[DE88-702324] N88-29592

WORKING FLUIDS
Reaction-theoretical aspects of the thermal behavior of lubricating oils and working fluids
[NASA-TT-20304] N88-29041

WORKSTATIONS
Automated software development workstation
N88-29423

X

X RAY DIFFRACTION
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579

X RAY LASERS
LLE (Laboratory for Laser Energetics) review
[DE88-008065] N88-29158
Modeling of atomic processes in X-ray laser plasmas
[AD-A194118] N88-29567

XENON
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193881] N88-28997

XENON FLUORIDE LASERS
Measurements of XeF (Xenon Fluoride) ground state dissociation and vibrational equilibration
[AD-A194611] N88-29527

Y

YTTRIUM
The high temperature creep deformation of Si3N4-6Y2O3-2Al2O3
[NASA-CR-183204] N88-28981

YTTRIUM OXIDES
Effects of metal substitutions (Fe and Ga) in YBa2Cu3O7 on its superconducting properties and microstructures
[DE88-007393] N88-29572
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583

Z

ZINC
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600

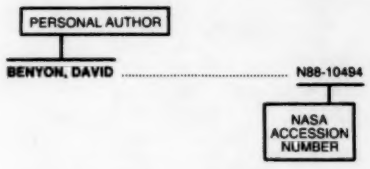
ZINC OXIDES
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

ZINC SELENIDES
Blue-green laser diode research program
[AD-A191980] N88-29153

ZIRCONIUM
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137

ZIRCONIUM OXIDES
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

ABIDI, MONGI ALI N88-29312
ACHE, GERARDO A. N88-29104
N88-29105
ACKERMAN, M. N88-29243
ACQUADRO, J. C. N88-28999
ADAMS, JOHN B. N88-29855
ADAMS, P. M. N88-29018
ADLER, RICHARD J. N88-29555
ADLER, ROBERT J. N88-29482
AGNEESSENS, D. N88-29295
N88-29299
AHUJA, RAVINDRA K. N88-29347
AHUMA, RAVINDRA K. N88-29471
AI, C.-S. N88-29421
AIHIE, V. U. N88-29476
AITA, CAROLYN R. N88-28986
AL-HUSSYNI, S. K. ALI N88-29109
AL-NASSAR, Y. N88-28967
ALBUGUES, F. N88-28969
N88-28977
N88-29169
ALGER, LINDA N88-29431
ALI, M. N88-29421
ALJABRI, ABDOLRAHMAN KHALID N88-29054
ALLISON, SIDNEY G. N88-29012
AMDIEU, M. N88-29127
N88-29128
AMIN, ASHOK T. N88-29393
ANDERSEN, KRISTINN N88-29376
ANDERSON, B. H. N88-29402
ANDERSON, C. N88-29212
ANDERSON, JOHN D., JR. N88-28885
ANDERSON, W. KYLE N88-28892
ANDERSSON, R. N88-29218
ANGENENT, SIGURD B. N88-29504
ANTONSEN, T. M., JR. N88-29156
ANTONUCCI, JOHN D. N88-29066
AOYAGI, KIYOSHI N88-28914
APOSTOL, M. N88-29576
APPLEBEE, D. J. N88-29682
ARCHER, RONALD D. N88-29019
ARDOIN, CY D. N88-29494
ARIMILLI, R. V. N88-28960
ARMIJO, J. R. N88-29213
ARVIDSON, RAYMOND E. N88-29655
ASARO, R. J. N88-29201
ASHLEY, C. S. N88-29214
ASKEW, E. W. N88-29301
ASSICE, A. N88-28976
ASSINK, R. A. N88-28988
ATKINSON, F. V. N88-29478
AUCEL, S. N88-29127
AUPOIX, B. N88-29121
AURAND, J. F. N88-29084
AUYEUNG, S. N88-28928
AYRES, R. N88-29159
AYRES, V. M. N88-29556

B

BABB, STEPHEN M. N88-29384
BABER, BURL B. N88-29017
BABY, B. V. N88-29508
BACON, L. D. N88-29084
BAER, ERIC N88-29029
BAESLACK, WILLIAM A., III N88-29009
BAHRI, ABBAS N88-29453
BAILEY, PATRICK A. N88-29394
BAILEY, RANDALL E. N88-28922
BAIN, COLIN D. N88-28991
BAKER, B. B. N88-29118
BAKER, M. C. N88-29584
BAKER, S. T. N88-29173
BAKER, WILLIAM H., JR. N88-28964
BALDIS, H. A. N88-29560
BALDWIN, R. J. N88-29700
BALKANSKI, M. N88-29598
BALMER, M. L. N88-29016
BALOGA, S. M. N88-29656
BANDLE, C. N88-29477
N88-29478
BANIN, A. N88-29667
BANKS, P. N88-28906
BANSAL, PREM N. N88-28927
BAR, S. X. N88-29087
BARANGER, M. N88-29473
BARBER, PATRICK G. N88-29048
BARBER, S. A. N88-29184
BARBIER, PIERRE N88-29146
BARDAWIL, CAROL N88-29447
BARLOW, NADINE G. N88-29657
BARRETT, ALAN H. N88-29062
N88-29276
BARRON, JOHN P. N88-29250
BARTOLOTTA, P. A. N88-28980
BARUT, A. O. N88-29508
N88-29624
N88-29625
N88-29626
BATINA, JOHN T. N88-28892
BAUCH, T. M. N88-29266
BAWIRZANSKI, EDUARD N88-29147
BAYDAR, ADEM N88-28936
BAYSAL, OKTAY N88-29116
BEALE, G. N88-29360
BEAM, RICHARD M. N88-29455
BEANE, ARTHUR J. N88-29424
BELL, J. D. N88-29562
BELL, JAMES F., III N88-29658
BEN-ARYEH, Y. N88-29530
BEN-JACOB, M. N88-29438
BENEDICT, WILLIAM L. N88-29238
BENEK, J. A. N88-29324
BEREZHNYJ, V. L. N88-29563
BEREZINSKIJ, V. S. N88-29710
BERG, RICHARD A. N88-29403
BERNARDI, MARIA INNES BASSO N88-29000
BERRY, J. N88-29535
BESTMAN, A. R. N88-29120
BEYER, H. N88-29605
BICKES, R. W., JR. N88-29046
BIEGL, C. N88-29390
BIGELOW, T. S. N88-29562
BIGLARI, H. N88-29371
BILHORN, ROBERT B. N88-28992
N88-28993
BILLAULT, P. N88-29085
BINIENDA, W. N88-28968
BIRCHENOUGH, ARTHUR G. N88-28942
BIRDSALL, C. K. N88-29564
BIRDSALL, CHARLES K. N88-29565
BIVENS, GRETCHEN A. N88-29089
BLACKFIELD, D. T. N88-29552
BLAIR, M. F. N88-28930
BLAKELY, ROBERT L. N88-29132
BLANEY, D. L. N88-29699
BLANEY, DIANA L. N88-29659
BLESS, S. J. N88-29199
BLOMBERG, L. G. N88-29244
BLONSKY, P. M. N88-29031
BOCHSLER, DANIEL C. N88-29356
BOCKO, MARK F. N88-29596
BOGGASCH, E. N88-29085
BOGUNOVIC, N. N88-29390
BOLDUE, MARK P. N88-29155
BOLLERMAN, BRUCE N88-29339
BOOSKE, J. H. N88-29156
BORIS, J. P. N88-29334
BORISON, HERBERT L. N88-29267
BOSLOUGH, M. B. N88-29660
BOTT, J. F. N88-29527
BOTTAFILHO, W. J. N88-29613
BOUCHET, F. R. N88-29644
BOURCIER, R. J. N88-29176
BOURRIEAU, J. N88-29535
BOWLES, DAVID E. N88-29982
BOY, GUY A. N88-29366
BOYNTON, W. V. N88-29671
BOZIC, M. N88-29624
BRAATEN, E. N88-29538
BRAITHWAITE, J. W. N88-29213
BRAKENRIDGE, G. R. N88-29661
BRANCH, LAURENCE G. N88-29274
BRANDON, CRAIG A. N88-29052
BRATTON, R. L. N88-29987
BRENNAN, D. H. N88-29292
BRINDLE, A. F. N88-29402
BRINDLEY, P. K. N88-29980
BRITT, DANIEL L. N88-29383
BROCKMAN, ROBERT A. N88-29034
BROGNIEZ, C. N88-29243
BROOMHEAD, D. S. N88-29436
BROWER, K. L. N88-29594
BROWN, HERBERT C. N88-28995
BROWN, I. G. N88-29558
BROWN, LARRY L. N88-29137
BRUCE, ROBERT L., JR. N88-29516
BRUNSON, P. N88-29428
BRYKCZYNSKI, BILL N88-29335
BUCHANAN, BRUCE G. N88-29327
BUCHAU, JURGEN N88-29237
BUCHNER, M. N88-29417
BUCKER, H. N88-29535
BUISINE, D. N88-29124
BUKLEY, A. P. N88-29364
BULAEVSKII, L. N. N88-29574
BULLMORE, A. J. N88-29523
BUNIN, BRUCE L. N88-28915
N88-28916
N88-28983
BURDIK, C. N88-29620
BURKE, STEVEN M. N88-29364
BURNAGE, HENRI N88-29134
BURNS, ROGER G. N88-29662
BUSACCA, ALAN N88-29210
BUSSEUIL, JACQUES N88-28954
BYRNES, JAMES S. N88-29055

C

CABRIC, B. N88-29607
CAI, SHENGSHAN N88-29606
CAILLE, GARY W. N88-29515
CALCOTE, ROCKY D. N88-29265
CALLAN, C. N88-29529
CAMARGO, G. D. M. N88-29174
CANAVAN, GREGORY H. N88-28948
CANTRELL, JOHN H. N88-29012
CARLE, G. C. N88-29667
CARNES, J. R. N88-29389
CARSON, DAVID L. N88-28962
CASATI, GIULIO N88-29623
CASTLES, STEPHEN H. N88-29050
CATTERMOLE, PETER N88-29663
CAZIER, F. W., JR. N88-28895
CHADWICK, PAULA MARY N88-29711
CHAN, Y. T. N88-29110
CHAN, Y. Y. N88-28865
CHANDRASEKARAN, B. N88-29434
N88-29633
CHANDRASEKHAR, H. R. N88-29582
CHANG, D. J. N88-29018
CHANG, KUNG-CHING N88-29459
CHANG, RICHARD K. N88-29164

CHANG, S. N88-29667
CHANG, SHUYEN N88-29664
CHAWNER, J. R. N88-29317
CHAY, SEUNG C. N88-29418
CHEN, IMAO N88-29357
CHEN, TIMOTHY S. N88-29040
CHEN, WAI-KAI N88-29086
CHEN, XIRU N88-29490
CHENG, YAAN N88-29210
CHENG, YE N88-29643
CHEO, B. R. N88-29139
CHINERY, DAVID N88-29206
CHLEBANOWSKI, JOSEPH S., JR. N88-29111
CHOINSKI, T. C. N88-29306
CHOU, TSU-WEI N88-28975
CHOU, WEN-HWA N88-29432
CHOUDRY, AMAR N88-29361
CHRISTENSEN, P. R. N88-29685
CHRISTIAN, J. W. N88-29613
CHRISTIANSEN, T. N88-29390
CHU, SHIRLEY S. N88-29595
CHU, TING L. N88-29596
CHUAH, H. N88-28974
CHULYA, ABHISAK N88-29195
CHUN, W. N88-29428
CHYLA, J. N88-29620
CIPOLLA, RUSSELL C. N88-29004
CIRAY, C. N88-28876
CLANCY, S. N88-29031
CLARK, BENTON C. N88-29665
CLARK, KIMBLE J. N88-29004
CLERE, J. M. N88-29282
CLIFFORD, STEPHEN M. N88-29666
CLIFTON, R. J. N88-29201
COGEOS, P. N88-29428
COHEN, R. E. N88-29026
COLCHIN, R. J. N88-29562
COLE, MICHAEL W. N88-28909
COLEMAN, JAMES H. N88-29048
COLLINS, CARL B. N88-29165
COLLINS, S. L. N88-29409
COLOMBANO, SILVANO P. N88-29391
COMBS, JACQUELINE B. N88-29416
COOK, GEORGE E. N88-29376
COOPER, LISA S. N88-29080
CORBIN-ROBERTS, LINDA N88-29044
CORSBERG, DAN N88-29359
COSTA RIBEIRO, P. N88-29143
COTTON, T. M. N88-29264
COUSTEIX, J. N88-29129
COUTO, J. G. V. N88-29174
COX, S. J. N88-29350
COYNE, L. M. N88-29667
CRABTREE, R. H. N88-28989
CRAWFORD, JAMES E., JR. N88-28941
CROSS, A. G. T. N88-28861
N88-28872
CRUME, E. C. N88-29582
CRUZ, ANGEL L. N88-29203
CUBUKCU, ARIF N88-29417
CUELLAR, J. P., JR. N88-29042
CULBERT, CHRIS N88-29396
CUMMINGS, W. G., III N88-28924
CUNNINGHAM, JOSEPH R. N88-28903
CURTIS, J. B. N88-29207
CUTLER, R. N88-29159
CUTTS, DANNIE E. N88-29370
CYMERMAN, ALLEN N88-29270
N88-29272

D

DABID, J. P. N88-29614
DADKHAH, M. S. N88-29202
DALE-BANNISTER, MARY N88-29655
DALEY, PHILIP C. N88-29415
DALTON, SHELLY D. N88-29415
DAMMANN, HANS N88-29098
DAS, ALOK N88-29203
DAS, BIKAS K. N88-29403
DAS, M. P. N88-29603
DAS, UTPAL N88-29575
DASILVEIRA, H. Y. N88-29593
DATTA, SUBHENDU K. N88-28967
DAVENPORT, ARTHUR K. N88-29132
DAVID, VALERIE N88-29713
DAVIDSON, GILBERT N88-29063
DAVIES, K. T. R. N88-29473
DAVIS, ELIZABETH N88-29404
DAVIS, PHILIP A. N88-29668
DAVIS, THOMAS J. N88-29059
DEAGUIAR, M. A. M. N88-29473
DEANCHIETARODRIQUES, JOSE N88-29000
DEARMOND, M. K. N88-28996
DEARSTONE, K. C. N88-29225
DEBENHAM, P. N88-29159
DEBNAM, WILLIAM J. N88-29048
DECASTRO, L. A. S. N88-29174
DEGEE, A. W. N88-29025
DEHON, R. A. N88-29669
N88-29670
DEJONG, GERALD F. N88-29501
DEMIRANDA, P. E. V. N88-29007
DEMMEL, JOHANN N88-29255
DENAPS, FRANK A. N88-29542
DENNER, WARREN W. N88-29262
DENTON, M. B. N88-29141
DENTON, M. BONNER N88-28992
N88-28993
DEOLIVEIRA, SERGIO P. N88-29007
DEOLIVEIRACASTRO, F. M. N88-29454
DESIMIO, MARTIN P. N88-29064
DESOUZA, L. A. N88-29198
DESTLER, W. W. N88-29156
DEY, PRADIP N88-29420
DIAL, A. L., JR. N88-29682
DIERKER, ROBERT R. N88-29497
DILLON, ROBERT E., JR. N88-28888
DIXON, L. C. N88-29435
DMOWSKI, W. N88-29011
DOBBS, B. N88-29090
DOBSON-HOCKEY, ANDREA KAY N88-29640
DOEHR, BRETT B. N88-29394
DOLGOV, O. V. N88-29574
DOLLMAN, THOMAS N88-29351
DONEGAN, T. L. N88-29324
DONG, BIZHEN N88-29609
DONOVAN, WILLIAM F. N88-29457
DOWELL, EARL H. N88-29514
DOWNS, MARY M. N88-29418
DOYLE, JOHN C. N88-29441
DRAIN, JOHN W. N88-29284
DRAKE, D. M. N88-29671
DRAPER, J. V. N88-29057
DRENT, KORNELIS HINDERIK N88-29303
DRING, R. P. N88-28930
DRISCOLL, JAMES R. N88-29470
DUDLEY, MICHAEL R. N88-28914
DUFFY, J. N88-29201
DUFRANE, K. F. N88-29184
DUNCAN, A. M. N88-29676
DUNLAP, J. L. N88-29582
DUONG, MINH DUC N88-29472
DUPUIS, PAUL N88-29496
DUPUY, SERGE N88-29449
DURHAM, RICHARD W. N88-29200
DUXBURY, ELIZABETH N88-29666
DVORAK, S. D. N88-28929
DYER, G. R. N88-29562
DYSON, F. N88-29529

E

EASTON, JAMES K., JR. N88-29901
EATOUGH, M. J. N88-29006
EBECKEN, N. F. F. N88-29198
EBERL, GUENTER N88-28905
EBERLE, A. N88-29319
ECKART, M. J. N88-29579
ECKSTEIN, MARTIN C. N88-28952
EDWARDS, ROBERT V. N88-29152
EDWARDS, STEPHEN E. N88-29494
EDWARDS, THOMAS R. N88-29369
EGAMI, T. N88-29011
EGOLF, T. ALAN N88-28880
EHST, D. A. N88-29561
EKATERINARIS, JOHN APOSTOLOS N88-29100
ELAZAR, YEKUTIEL N88-29112
ELGIN, JAMES B. N88-28945
ELHAFFAR, H. N88-29178
ELLIS, J. N88-29710
ELMES, DAVID ANTONY N88-29206
ELSENAAR, A. N88-28862
N88-28864
N88-28866
N88-28867
ENGELBECK, R. M. N88-28917
ENGLAND, A. C. N88-29562
ENGLAND, JANINE V. N88-29486
ENGLERT, P. N88-29671
EPPERSON, P. M. N88-29141
EPPERSON, PATRICK M. N88-28992
N88-28993
ERIKSSON, LARS-ERIK N88-29318
ESTES, ROBERT D. N88-28950
EVANS, G. A. N88-29476
N88-29568
EVANS, K., JR. N88-29561
EVANS, L. G. N88-29671
EVATT, THOMAS C. N88-29412
EWICK, D. W. N88-29046
EYMAR, PATRICK N88-28943

F

FACEMIRE, JON N88-29357
FACIUS, R. N88-29535
FAGAN, JOEL L. N88-29634
FALTER, JEFFREY J. N88-29330
FANALE, F. P. N88-29688
FARKAS, D. N88-29014
FATEMAN, RICHARD J. N88-29340
FAUCHEUX, J. F. N88-29614
FEGLEY, BRUCE N88-29689
FEIGENBAUM, EDWARD A. N88-29327
FELDMAN, W. C. N88-29671
FERNANDEZ, J. P. N88-29247
FERNANDEZ, K. R. N88-29360
FERNANDEZ, KEN N88-29388
FIOCCO, G. N88-29243
FISH, JOHN P. N88-29177
FISHER, DUNCAN S. N88-29662
FISHER, E. M., JR. N88-29377
FLAHERTY, JOSEPH E. N88-29484
FLEETWOOD, D. M. N88-29082
FLEMING, WENDELL H. N88-29442
FLORENCE, G. N88-29282
FLOYD, STEPHEN N88-29358
FLUCKIGER, DAVID U. N88-29155
FODOR, G. E. N88-29042
FOGT, HANNES N88-28890
FORD, DONNIE N88-29358
FORSYTH, E. B. N88-29586
FOUGHT, STEPHEN O. N88-29493
FOUNDS, N. D. N88-29182
N88-29183
FRANCHI, PETER R. N88-29066
FRANCIS, P. W. N88-29672
FRANK, K. N88-29085
FRAZIER, B. E. N88-29210
FREEMAN, GARTH B. N88-28973
FREEMAN, MICHAEL S. N88-29406
FREIMAN, S. W. N88-29016
FRENKEL, GABRIEL N88-29495
FREUND, L. B. N88-29080
N88-29194
N88-29201
N88-29577
FRIEDMAN, FRED N88-29335
FRITZ, W. N88-29323
FRY, LARRY N88-29447
FULCO, CHARLES S. N88-29270
FULLER, W. H., JR. N88-29234
FURUNO, G. N88-29003

G

GABOW, HAROLD N. N88-29348
N88-29348
N88-29470
GADDIS, JOSEPH L. N88-29052
GALLEGO, L. N88-29266
GALLIMORE, FRANK H. N88-29051
GALLO, GIORGIO N88-29345
GALVAO, C. A. P. N88-29505
GALVIN, A. B. N88-29947
GALVIN, J. E. N88-29558
GAMAL, YOSR. E. E-D. N88-29168
GAMBANIS, STAMATIS N88-29482
GANDHI, OM P. N88-29268
GANGULI, G. N88-29557
GARRETT, BRUCE C. N88-29047
GAUTHIER, V. N88-29125
GEETHA, K. N88-29219
GENT, A. N. N88-29030
GEOFFROY, AMY L. N88-29383
GEORGE, NICHOLAS N88-29545
GEORGE, THOMAS F. N88-28997
GERARD, GEOVING J. N88-28973
GERASIMAS, BERNARD F., JR. N88-29279
GEVIRTZ, J. L. N88-29207
GHIA, KIRTI N. N88-29114
GHIA, URMILA N88-29114
GHOLDSTON, EDWARD W. N88-29412
GHOSH, RUPAMANJARI N88-29541
GILATH, IRITH N88-28971
GILL, STEVE N88-29210
GILLOTAY, D. N88-29228
GINLEY, D. S. N88-29578
GIOVANNINI, R. N88-29127
GIUFFRIDA, MARIA R. N88-29262
GLASS, BRIAN JAY N88-29437
GLOECKLER, G. N88-28947
GLOWIENKA, J. C. N88-29562

GLYNN, J. L. N88-28881
GOBBI, P. N88-29243
GOHRING, JOHN R. N88-29383
GOLDBERG, ANDREW V. N88-29468
N88-29469
GOLDMAN, ZVI Z. N88-29269
GOLDSTEIN, MARTIN N88-29055
GOLSHANI, FOROUZAN N88-29365
GOODE, GREGORY L. N88-29337
GOODING, J. L. N88-29673
GOODWIN, MARY ANN N88-29356
GORANSSON, PETER N88-29519
N88-29520
N88-29521
GORDON, D. F. N88-29517
GORDON, N. T. N88-29097
GORNIK, ERICH N88-29601
GOSS, ERNST N88-29355
GOTTLIEB, S. A. N88-29621
GRAESSER, D. L. N88-29202
GRANATSTEIN, V. L. N88-29156
GRANOFF, B. N88-29043
GRANT, J. A. N88-29674
GRAVANO, S. M. N88-29013
GRAVES, SARA J. N88-29353
GRAY, G. T., III N88-29197
GRAY, K. E. N88-29583
GREELEY, R. N88-29675
GREEN, M. A. N88-29581
GREENE, RICHARD J. N88-29372
GREITZER, FRANK L. N88-29405
GRICE, ROGER ALAN N88-29635
GRIFFITHS, J. B. N88-29629
N88-29630
GRIGORIADIS, MICHAEL D. N88-29345
GROELE, ROBERT J. N88-29027
GROTBERG, J. B. N88-29107
GROTCH, S. L. N88-29248
GROVER, JEFFREY L. N88-29387
N88-29410
GRUBER, JOHN B. N88-29599
GRUBER, ROBERT P. N88-28939
GRUHLKE, RUSSELL WAYNE N88-29540
GU, BENYUAN N88-29609
N88-29612
GUAY, K. P. N88-29006
GUCKENHEIMER, JOHN N88-29209
GUDERLEY, KARL G. N88-28887
GUENTHER, H. N88-28963
GUEST, J. E. N88-29676
GUINNESS, EDWARD A. N88-29655
GULINO, DANIEL A. N88-28966
GULLAHORN, GORDON E. N88-28950
GUPTA, SHANTI S. N88-29450
N88-29484
GUTMARK, EPHRAIM N88-28994

H

HAAS, NORBERT KURT N88-29617
HAASE, W. N88-29323
HADDAD, A. H. N88-29462
HAERTING, ALEXANDER N88-28952
HAGER, BRADFORD H. N88-29231
HAGER, G. D. N88-29092
HAGGERTY, JOHN S. N88-29024
HAGIWARA, MIYUKI N88-29023
HAINES, A. B. N88-28864
N88-28866
N88-28867
N88-28868
HALE, G. M. N88-29554
HALL, G. F. N88-28882
HALL, HENRY K., JR. N88-29078
HALL, STEVEN B. N88-29378
HALLIBURTON, LARRY E. N88-29543
HALLIWELL, J. W. N88-29562
HAMILTON, ALLAN J. N88-29272
HAMILTON, MARC N88-29381
HAN, CHIA YUNG N88-29362
HANCK, K. W. N88-28996
HANDEL, S. J. N88-29057
HANIFEN, DAN W. N88-29332
HANKINS, ROBERT J. N88-29187
HANSEN, A. D. A. N88-29138
HARADA, Y. N88-29003
HARDIMAN, CHRISTOPHER J. N88-29019
HARDY, D. A. N88-29244
HARDY, L. C. N88-29031
HARRIS, C. S. N88-29031
HARRIS, STEVEN G. N88-29204
HARROLD, C. L. N88-29307
N88-29309
HART, JUDY N88-29210
HARTKE, DARRELL D. N88-29286
HARTMANN, C. R. N88-29438
HARTMANN, FRANCIS X. N88-29161
HARTS, J. M. N88-29296
HASENACK, C. M. N88-29531
HAUER, A. N88-29579
HAUER, A. A. N88-29560
HAUF, THOMAS N88-29245
HAVEY, C. T. N88-28917
HAWKINS, J. N88-29379
HAWKINS, PATRICK J. N88-29378
HAWKINSON, LOWELL N88-29419
HAYS, DAN N88-29401
HAYTON, G. E. N88-29479
HAYWOOD, JAMES WILLIAM N88-29641
HEGEDUS, CHARLES R. N88-28878
HEIDNER, R. F. N88-29527
HEIKKILAE, M. N88-29218
HEINBACH, C. N88-29438
HEINE, BRUCE N88-29693
HELM, MANFRED N88-29601
HELMHOLD, ROBERT L. N88-29343
HELMINIAK, T. E. N88-28974
HENNESSY, JOHN F. N88-29426
N88-29427
HERANT, M. N88-29708
HEREMAN, WILLY N88-29452
N88-29458
HERMAN, DANIEL H. N88-29352
HERMAN, M. N88-29243
HERNDON, J. N. N88-29057
HESHMAT, H. N88-29172
HESS, G. N88-29144
HESS, ROBERT W. N88-28895
HEXMOOR, H. N88-29395
HIBEY, JOSEPH L. N88-29257
HIBSON, D. V. N88-29163
HIENSTORFER, WOLFGANG G. N88-28899
HIKAMI, SHINOBU N88-29588
HILLIARD, KERRY N88-29335
HILLS, MARIAN E. N88-29599
HIRATA, D. N88-29157
HIROSE, Y. N88-29618
HIRSCH, JOY N88-29273
HIRST, DONALD J. N88-28878
HIXSON, ROY L., III N88-28935
HO, CHIH-MING N88-28884
HO, HWAI-CHUNG N88-29488
HO, THI PHUONG N88-29608
HOBALLAH, IMAD Y. N88-29446
HODGDON, M. L. N88-29510
HOEKSEMA, J. T. N88-29708
HOFFMANN, HANS-EBERHARD N88-29255
HOFMANN, FRANZ N88-29616
HOLLISTER, WALTER M. N88-28934
HOLLOWAY, J. S. N88-29527
HOLT, DAVID M. N88-28937
HOOK, AUDREY A. N88-29335
HORBONNEAU, A. N88-28978
HORNECK, G. N88-29535
HORSTHUIS, WINFRIED HENRI GERARD N88-29548
HOSIER, R. N. N88-29407
HOSNY, W. M. N88-28929
HOWE, M. S. N88-29522
HSIAO, MING-YUAN N88-29561
HSIEH, B. J. N88-29360
HSU, IN-SHEK N88-28946
HSU, MING-TA S. N88-29040
HU, Y. N88-29577
HUANG, S. N. N88-29647
HUDEC, CHRIS L. N88-29222
HUDIK, FRANK E. N88-29338
HUFF, E. A. N88-29583
HUGHES, J. W. N88-29676
HUHTINEN, M. N88-29218
HUITEMA, GREGORIUS BONIFATIUS N88-29513
HUMPHREYS, D. N88-29129
HUMPHREYS, D. A. N88-29126
HUMPHREYS, R. H. N88-29092
HUMPHRIES, S., JR. N88-29144
HUNT, M. J. N88-29058
HUNT, W. H. N88-29234
HURD, WILLIAM J. N88-29076
HUSCHKE, RALPH E. N88-29249
HWANG, Y.-C. N88-29030

I

IOFFE, B. L. N88-29710
IPAVICH, F. M. N88-28947
IPSEN, ILSE C. N88-29344
ISHIKAWA, MASAYASU N88-29588

J

JAAP, JOHN N88-29404
JACKSON, T. N. N88-29080
JAEGER, M. N88-29243
JAKOSKY, B. M. N88-29685
JALKIAN, R. D. N88-29141
JAMIESON, P. N88-29212
JANNARONE, ROBERT J. N88-29277
N88-29491
JANSSEN, TERRY N88-29403
JATEGAONKAR, RAVINDRA N88-28911
JAYARAMAN, BHARAT N88-29341
N88-29466
JEFFERS, WILLIAM N88-29166
JENKINS, D. B. N88-28906
JESSUP, ELIZABETH R. N88-29344
JIANG, WEI-SI N88-29362
JIN, KEJIAN N88-29650
JING, SUN N88-28946
JOHNSON, B. C. N88-29159
JOHNSON, DANIEL E. N88-29092
JOHNSON, MARIE N88-29693
JOHNSON, MARK N88-29448
JOHNSON, RICHARD F. N88-29274
JOHNSON, STEWART N88-29209
JONES, Y. D. N88-29162
N88-29163
JORDAN, HARRY N88-29429
JORDAN, HARRY F. N88-29430
JOSLYN, H. D. N88-28930
JULIEN, C. N88-29598
JURCZYSZYN, L. N88-29604

K

KAHN, TAHER ALI N88-28944
KAISER, DONALD LEO N88-29378
KAMHIEH, CYNTHIA H. N88-29370
KAMPWIRTH, R. T. N88-29583
N88-29584
KANG, J. H. N88-29583
KANNEL, J. W. N88-29184
KAPPEL, MICHAEL R. N88-29494
KARMAN, S. L., JR. N88-29317
KARMAN, T. N88-29605
KARSAI, G. N88-29390
KARWAN, MARK H. N88-29336
KAUFMAN, LLOYD N88-29143
N88-29275
N88-29276
KAUTZMANN, FRANK N., III N88-29413
KAWAMURA, K. N88-29360
N88-29371
KAWANISHI, SHUNICHI N88-29023
KAY, B. D. N88-28988
KAZAKOV, D. I. N88-29619
KAZMIERCZAK, H. N88-29208
KEATING, P. N88-29092
KEGELMAN, JEROME T. N88-28889
KEHR, JOACHIM G. N88-29223
KELLY, J. N88-29158
KEMP, ALEXANDER N88-29431
KEMP, R. D. N88-29034
KENDALL, WILLIAM B. N88-29487
KESTEL, B. J. N88-29584
KHALAF, CAMILLE S. N88-29257
KHANDKAR, A. C. N88-29215
KIBENS, VALDIS N88-28889
KIEFFER, HUGH H. N88-29677
KILCHINSKAYA, G. A. N88-29631
KILKENNY, J. D. N88-29579
KING, CHUNG-TA N88-29432
KING, ELBERT A. N88-29678
KING, SANDY N88-29447
KIPP, JACOB W. N88-29502
KIRK, M. A. N88-29584
KIRSCHNER, T. N88-29605
KISS, P. A. N88-29364
KIUTTU, GERALD F. N88-29555
KLAHR, PHILIP N88-29423
KLAMKA, A. N88-28917
KLEIN, VLADISLAV N88-29489
KLEINAU, W. N88-28963
KLEPPNER, DANIEL N88-28990
KLIMA, S. J. N88-28980
KLOEPPER, A. H. N88-29130
KLON, PETER F. N88-29354
KNAPP, B. G. N88-29709
KNUTSEN, DOUGLAS W. N88-29285
KOBAYASHI, A. S. N88-29202
KOCZAK, MICHAEL N88-29005
KOEHNLEIN, WALTER N88-29241
N88-29242

KOENIG, A. A. N88-29213
KOENIG, DAVID G. N88-28914
KOENIG, GEROLD N88-29122
KOFFEND, J. B. N86-29527
KOHL, K. B. N88-29042
KOKTA, MILAR R. N88-29599
KOLLIEN, J. N88-28963
KONONENKO, V. I. N88-29563
KORDULLA, W. N88-29129
KOSS, D. A. N88-29010
KOSUT, ROBERT L. N88-29439
KOVACS, G. N88-29605
KRAAIJEVANGER, JOHANNES FRANCISCUS BERNARD N88-29474
KRAFT, EDWARD M. N88-28875
N88-28877
KREIN, B. A. N88-29407
KREISEL, GEORGE R. N88-28923
KREUTZ, K. N88-29328
KRISTIANSEN, D. N88-29349
KRONGAUZ, VALERI N88-29544
KROTHAPALLI, A. N88-28866
KRZYSZTOF, K. N88-29049
KUGEL, C. P. N88-28902
KUGELMANN, BERND N88-28953
KUNHARDT, ERICH E. N88-29079
KUNKEL, JEFFREY S. N88-28972
KUNO, YOSHITAKA N88-29588
KURATA, N. N86-29003
KURKOV, ANATOLE P. N86-29142
KURYLO, M. J. N88-29233
KUSHNER, HAROLD N88-29496
KUSHNER, MARK J. N88-29094
KWOK, M. A. N88-29527
KWON, YOUNGJOO N88-29192

L

LACKEY, W. J. N88-28973
LADSON, CHARLES L. N88-28879
LAFON, A. N88-29121
LAHMEYER, CHARLES R. N88-29310
LAI, TZE L. N88-29443
LAMANNA, CATHERINE A. N88-29433
LAN, C. EDWARD N88-28891
LARSON, GERALD E. N88-29269
LASKEY, K. J. N88-29334
LAST, ISIDORE N88-28997
LASTER, MARION L. N88-28893
LATTIN, KATHRYN E. N88-29269
LAUGHLIN, JAMES E. N88-29491
LAZAREV, YU. A. N88-29570
LEE, ANNABEL Y. N88-29019
LEE, CHARLES C. N88-28974
LEE, EUN U. N88-28925
LEE, R. W. N88-29579
LEE, Y. C. N88-29557
LEE, YOUNG M. N88-29528
LEFEBVRE, A. H. N88-28924
LEFLOCH, C. N88-29189
LEGER, A. N88-29282
LEGG, S. J. N88-29271
LEIBOLD, ALOIS N88-28952
LEINWEBER, DAVID N88-29419
LEISAWITZ, DAVID N88-29652
LEMOS, N. A. N88-29505
LENOBLE, J. N88-29243
LEONHARDT, M. H. N88-29306
LESAR, R. S. N88-29987
LESPADE, P. N88-29038
LESZCYNSKI, LINDA N88-29447
LEVIN, ALAN D. N88-28918
LEWIS, CLAYTON N88-29342
LEWIS, JAMES K. N88-29252
LEWIS, M. E. N88-29549
LI, YU-MING N88-29518
LIANG, TACHEN N88-29450
LIBELO, LOUIS F. N86-29511
LICHFIELD, E. W. N86-29230
LIEM, RONNIE N88-29059
LIJEWSKI, LAWRENCE E. N88-29321
LIM, CHONG-SA N88-29707
LIN, JIANCHENG N88-29512
LIN, P. S. N88-29377
LINDEFELT, U. N86-29573
LINDHOUT, J. N88-29129
LINKER, JON ANDREW N88-29704
LINKOHR, ALBRECHT N88-29096
LINN, CATHY JO N88-29494
LINN, JOSEPH L. N88-29494
LIPPENS, C. N88-29243
LIU, DA-KANG N88-29205
LIU, HSUEH-WEN N88-29093
LIU, J. W. S. N88-29311
LIVI, R. P. N88-29999
LOEBEL, HEINZ N88-29255
LOGAN, KEVIN P. N88-28904
LONG, YIMING N88-29457
LONGDON, NORMAN N88-29713
LONGHI, JOHN N88-29679
LOPARO, K. N88-29417
LOPES, J. LEITE N88-29531
LORBER, PETER F. N88-28880
LORD, CARTER K. N88-29302
LORENZINI, ENRICO C. N88-28950
LOUIE, JOHN NIKOLAI N88-29235
LOURENCO, L. N88-28886
LOVELAND, ROHAN C. N88-29095
LOWE, D. N88-29436
LU, CHIN N88-29311
LUCAS, H. N88-28979
LUCCHITTA, B. K. N88-29680
LUCEY, P. G. N88-29692
LYABLIN, M. V. N86-29232
LYNCH, NANCY A. N88-29333
LYONS, D. F. N88-29060
LYSENKO, W. P. N88-29537

M

MAANY, Z. A. N88-29435
MACKAY, G. I. N88-29226
MACKINNON, DAVID J. N88-29681
MAGRET, V. L. N88-28978
MAHONEY, A. R. N88-29214
MALDONADO, R. H.C. N88-29712
MALTA, C. P. N88-29473
MANNING, ROBERT M. N88-29077
MAR, H. A. N88-29153
MARCIANO, WILLIAM J. N88-29707
MARKLUND, G. T. N88-29244
MAROTTE, H. N88-29282
MARSHALL, LYNNE N88-29280
MARTIN, B. G. N88-29091
MARTIN, DONALD F. N88-28942
MARTIN, J. C. N88-29407
MARTINEZ, J. I. N88-29221
MARX, M. N88-29026
MARYANSKI, FRED N88-29638
MASILAMANI, V. N88-29167
MASSAQUOI, J. G.M. N88-29252
MASSONNE, LUTZ N88-29651
MASUDA, YASUSHI N88-29305
MASURSKY, HAROLD N88-29682
MAYERGOYZ, I. D. N88-29156
MCATEE, MICHAEL D. N88-29246
MCCONNELL, ROGER A. N88-28919
MCCORD, R. A. N88-29225
MCCORD, T. B. N88-29699
MCCORD, THOMAS B. N88-29658
N88-29659
MCEWEN, A. H. N88-29069
MCFADDEN, L. A. N88-29683
MCGAUGH, CHARLES L., JR. N88-28897
MCGHEE, ROBERT B. N88-28940
MCGILL, GEORGE E. N88-29684
MCGUINNESS, M. J. N88-29217
MCHENRY, JEFFREY J. N86-29287
MCINGVALE, PAT N88-29368
MCKENNA, PAUL M. N88-29258
MCMENEMY, DONNA J. N88-29274
MCNALLY, PATRICK J. N88-29080
MCNAMARA, LEO F. N88-29237
MCNEIL, C. L. N88-28917
MEGIE, G. N88-29243
MEHLHORN, KURT N88-29347
MEIER, G. E. N88-28883
MEIKE, ROGER N88-29385
MELDON, JERRY H. N88-29033
MENDLER, ANDREW P. N88-29380
MENICUCCI, D. F. N88-29247
MENS, J. W. N88-29025
MENZEL, H. G. N88-29148
MERKLE, CHARLES L. N88-29113
MERRITT, CHARLES R. N88-29289
MIAMEE, A. G. N88-29481
MICCI, MICHAEL M. N88-29113
MICHEL, ROGER N88-28871
MIDDLETON, ROBERT D., JR. N88-29516
MILEY, S. J. N88-28882
MILLER, J. M. N88-29263
MILLER, STEVEN S. N88-29465
MIN, NAMKUNG N88-29012
MIODUSZEWSKI, P. K. N88-29562
MITCHELL, R. L. N88-29220
MITCHELL, T. E. N86-29580
MITOMA, ITARU N88-29456
MIYATAKE, HIDEAKI N88-29588
MOM, A. J. A. N88-28926
MOODENBAUGH, A. R. N88-29572
MOORE, D. S. N88-28987
MOORE, H. J. N88-29085
MOORE, PETER K. N88-29464
MORESHEAD, WILLIAM V. N88-29154
MORIARTY, ROBERT M. N88-29039
MORISON, WILLIAM DONALD N88-28970
MOROSIN, B. N88-29578
MORRIS, C. E. N88-29197
MORRISON, CLYDE A. N88-29599
MOSCHETTI, B. N88-29127
N88-29128
MOSKOWITZ, WARREN P. N88-29063
MOTOJIMA, O. N88-29550
MOUGINIS-MARK, PETE N88-29686
MOYNIHAN, C. T. N88-29032
MUKI, R. N88-29018
MULCAHY, T. M. N88-29107
MULLER, S. N88-29569
MURPHREE, J. S. N88-29244
MURPHY, JOHN H. N88-29418
MURPHY, O. N88-29438

N

NAEGELI, D. W. N88-29042
NAGLE, D. N88-28928
NAGLE, GAIL N88-29431
NAGY, KORNEL N88-29181
NAHRA, HENRY K. N88-28959
NAJJAR, BASSAM N88-29196
NAKAZAWA, YASUHIRO N88-29588
NASSER, A. L. N88-28961
NAVIAOJEDA, C. E. N88-29712
NEEDLEMAN, A. N88-29201
NEELEN, NEELE N88-29131
NELSON, L. S. N88-29006
NELSON, P. A. N88-29522
NELSON, R. N88-29389
NESTERENKO, V. V. N88-29053
NEUFER, P. D. N88-29281
NEURGAONKAR, R. R. N88-29597
NEVES, JOAO M. N88-29099
NEWMAN, DONALD J. N88-29055
NEWMAN, RICHARD L. N88-28921
N88-28922
NGUYEN, VAN KHAI N88-29608
NGUYEN, VAN SUNG N88-29608
NI, L. M. N88-29432
NICKLAS, BURKHARD N88-29015
NILSSON, MATS N88-29626
NISHIDA, NOBUHIKO N88-29588
NITSCHE, W. N88-29123
NJAU, E. C. N88-29070
N88-29071
N88-29072
N88-29253
N88-29254
NOURINEJAD, ABDOLHOSSEIN N88-29101
NOVAKOV, T. N88-29138
NUROH, K. N88-29526
NUSCA, MICHAEL J. N88-29119
NUTTALL, ALBERT H. N88-29492

O

OBEID, NADIM N88-29440
ODEN, J. TINSLEY N88-29115
OETKEN, R. E. N88-29304
OFFENHAEUSER, FRIEDRICH N88-29169
OFFERMANN, EDMOND ARNOLD JEAN MARIE
N88-29536
OHLER, PETER C. N88-29373
OHSAWA, YUKIHARU N88-29706
OKUMA, SATOSHI N88-29588
OKUN, L. V. N88-29705
OLINER, ARTHUR A. N88-29079
OLIVER, MICHAEL R. N88-28940
OLSON, R. J. N88-29225
ONEIL, GRAHAM N88-29447
ORAN, E. S. N88-29334
ORENBERG, J. B. N88-29667
ORLIN, JAMES B. N88-29347
N88-29471
OSBORN, M. T. N86-29234
OSBORNE, HAYWOOD S. N88-29392
OSMAN, ARAFA MOHAMED N88-29108
OTT, E. N88-29156
OTUBO, J. N88-29592
OVERLEY, M. S. N88-29537

P

PACHURA, DAVID W. N88-29380
PACKARD, ANDREW N88-29441

PADALKAR, S. N88-29360
N88-29371
PADOVAN, JOE N88-29480
PAIGE, M. A. N88-29017
PAINE, B. M. N88-29087
PAIVA, F. M. N88-29622
PAKTUNA, MUSTAFA N88-29188
PALAMIDES, T. R. N88-29016
PALMADESSO, P. J. N88-29557
PALMER, M. R. N88-29163
PAMUK, TURGAY N88-29088
PAN, VIVIAN N88-29679
PANDEY, A. N. N88-29525
PAPANTONI-KAZAKOS, P. N88-29060
PARKER, STEVEN L. N88-29258
PARKER, TIMOTHY J. N88-29687
PARKIN, B. R. N88-29118
PASCHEN, K. W. N88-29018
PATERSON, THOMAS S. N88-29495
PAVLICHENKO, O. S. N88-29563
PAYNE, R. C. N88-29524
PAZENNY, ALEXANDER A. P. N88-29227
PCHELKIN, N. R. N88-29162
PEHRSSON, KIRSTEN M. N88-28923
PELETIER, L. A. N88-29477
N88-29478
PELON, J. N88-29243
PENNER, S. N88-29159
PERALA, RODNEY A. N88-29258
PERRY, JOHN N88-29419
PETERS, HANNS-JUERGEN N88-28913
PETERS, PALMER N. N88-29602
PETERSON, JOHN B., JR. N88-28859
PHALIPPOU, J. N88-29038
PHILIPPON, J. P. N88-29535
PIERRE, C. N88-29037
PING, TCHENG N88-29145
PINKUS, ALAN R. N88-29297
N88-29298
PINNOCK, W. N88-29188
PINTER, MICHAEL W. N88-28920
PINTO, F. A. N88-29712
N88-29712
PINTO, H. V. N88-29712
PISANE, GUY E. N88-29611
PITCHER, CHARLES SPENCER N88-29566
PITTS, JOAN I. N88-29316
PLAETSCHKE, ERMIN N88-28911
PLOTARD, P. N88-28977
POHL, HANS-WILHELM N88-28912
POON, S. J. N88-29011
POORMAN, RICHARD M. N88-28938
PORATH, M. N88-29590
PORJESZ, T. N88-29605
PORTELLA, H. M. N88-29712
POSTAWKO, S. E. N88-29688
POTEMRA, T. A. N88-29244
POTTELETTE, R. N88-29244
POTTER, J. LEITH N88-28858
N88-28869
POTTER, KEVIN DAVID N88-29179
POTTS, J. E. N88-29153
POUCHER, D. E. N88-28881
POUND, BRUCE G. N88-29006
PRATHER, M. J. N88-29233
PREMA, K. N88-29219
PRICE, JOHN M. N88-29115
PRIMAS, LORI E. N88-29095
PRINCE, A. N88-29107
PRINN, RONALD N88-29689
PRIOR, LORRAINE A. N88-29155
PRIOU, A. N88-28976
PRITCHARD, RICHARD H. N88-29364
PROUSE, D. W. N88-29215
PROUTY, DALE A. N88-29423
PRUESS, K. N88-29217
PRZYBYLINSKI, STANLEY M. N88-29382
PTITSYN, M. O. N88-29574
PUGH, A. C. N88-29479
PULSIFER, PETER EMERY N88-29551
PURINTON, STEVEN C. N88-29411
PURVES, B. N88-29371
N88-29390
N88-29395
PURVES, R. B. N88-29377
N88-29407
N88-29409
PURVES, R. BYRON N88-29370
N88-29410
PUSTER, RICHARD L. N88-29002

Q

QUEIROZ, MARDSON N88-28985

R

RABINOWITZ, PAUL H. N88-29451
N88-29453
RADESPIEL, R. N88-29325
RAHIMIAN, ERIC N. N88-29353
RAIZENNE, M. D. N88-28926
RAJAMONEY, SHANKAR A. N88-29501
RAJENDRAN, A. M. N88-29199
RAMIREZ, JEAN-CLAUDE N88-29080
RANGANATH, H. S. N88-29368
RARD, J. A. N88-28964
RAZZAQ, ZIA N88-29196
REBARBER, RICHARD N88-29481
REBOUCAS, M. J. N88-29622
REDDI, M. M. N88-28908
REDDY, E. S. N88-28968
REDMOND, I. N88-29212
REED, IRVING S. N88-28948
REED, S. T. N88-29214
REEDY, R. C. N88-29671
REID, D. W. N88-29083
REINISCH, BODO W. N88-29237
REISS, E. L. N88-29107
REITZ, G. N88-29535
REKIOUAK, A. N88-29139
RENAULT, HERVE N88-28954
RENKEN, JUERGEN N88-28932
RICCITIELLO, SALVATORE R. N88-29040
RICH, F. J. N88-29244
RICHTER-SAND, ROBERT J. N88-29555
RIEGE, H. N88-29085
RIETHMULLER, M. L. N88-29125
RILEY, GARY N88-29399
RISTOVSKI, L. N88-29607
ROBBINS, DONALD W. N88-29539
ROBBINS, HERBERT N88-29443
ROBERTS, S. J. N88-29475
ROBINSON, MARK S. N88-29690
ROBINSON, S. E. N88-29278
ROCHOWIAK, DANIEL N88-29363
ROCHSTRASSER, ROBIN M. N88-29548
RODRIGUEZ-MOSCOSO, J. N88-29360
N88-29371
RODRIGUEZ, FERDINAND N88-29027
RODRIGUEZ, G. N88-29328
ROEBELEN, GEORGE J., JR. N88-29132
ROETHEL, F. N88-29182
ROGERS, J. W., JR. N88-29578
ROGIER, R. N88-29038
ROIZES, A. N88-29614
ROOS, FREDERICK W. N88-28889
ROSE, SHARON R. N88-29287
ROSE, WILLIAM C. N88-28896
N88-29108
ROSENBERG, JAMES J. N88-29080
ROSENTHAL, DONALD A. N88-29396
ROSS, P. N., JR. N88-29571
ROTEL, M. N88-29090
ROTH, L. E. N88-29691
ROTHMAN, HUGH B. N88-29382
ROTMAN, STANLEY R. N88-29161
ROTTMAN, G. J. N88-29709
ROUBERTIE, JEAN M. N88-28943
ROULLARD, PETE N88-29547
ROUSH, E. A. N88-29692
ROUSH, T. L. N88-29692
ROUX, M. N88-29535
ROY, T. N88-29580
ROZENDAAL, RODGER A. N88-28894
RUD, L. A. N88-29056
RUDOLPH, TERENCE H. N88-29258
RUGH, WILSON J. N88-29445
RUITENBURG, GIJSBERTUS CORNELIS MICHAEL
N88-29509
RUSSO, G. P. N88-28863
RUTHERFORD, M. J. N88-29693
RYDING, DAVID G. N88-29600

S

SAAVEDRA, A. N88-29007
SABATINI, R. L. N88-29572
SAGE, HEINZ N88-29368
SAGUI, R. L. N88-28916
SAIF, A. G. N88-29603
N88-29611
SAKAI, JUN-ICHI N88-29706
SALAMIN, Y. I. N88-29626
SALOMON, R. E. N88-29216
SALZMANN, DAVID N88-28971
SAMORODNITSKY, GENNADY N88-29480
N88-29482
SAUNDERS, R. S. N88-29691
SAUNDERS, R. STEPHEN N88-29687
SAVAGE, BLAIR D. N88-29648
SAVINO, E. J. N88-29014
SAVKOOR, ARVIN RAMACHANDRA N88-29036
SAWKA, MICHAEL N. N88-29281
SCANLON, RAYMOND N88-29448
SCATTERGOOD, T. W. N88-29667
SCHAFER, M. N88-29535
SCHEIN, MICHAEL E. N88-29050
SCHERRER, P. H. N88-29706
SCHIFERL, D. N88-29667
SCHIFF, H. I. N88-29228
SCHIRBER, J. E. N88-29578
SCHLOBOHM, S. L. N88-29046
SCHMALE, D. T. N88-29176
SCHMID, O. N88-29073
SCHMIDT, DEBORAH D. N88-28938
SCHMIDT, SUSAN B. N88-28914
SCHMITT, HANS-JURGEN N88-29098
SCHNEIDER, WILLIAM C. N88-29181
SCHOTT, J. U. N88-29535
SCHROEDER, J. N88-29032
SCHROEDER, ROBERT L. N88-29374
SCHULTZ, P. H. N88-29674
N88-29694
SCHULTZ, RYAN R. N88-29251
SCHULZE, K. W. N88-29041
SCHWAGER, L. A. N88-29564
SCHWAN, KARSTEN N88-29434
SCHWARZ, W. N88-29319
SCHWEIG, H. N88-28963
SCOTT, DAVID H. N88-29695
SCRUGGS, ROY N88-29410
SEEBOECK, R. N88-29085
SEIBERT, W. N88-29323
SEIDENBERG, BENJAMIN N88-29133
SHABALIN, D. E. N88-29232
SHACHAM, NACHUM N88-29067
SHAH, ARVIND H. N88-28967
SHAPIRO, W. N88-29172
SHARMA, R. D. N88-29239
SHARMA, R. K. N88-29525
SHARP, M. A. N88-29271
SHARPTON, V. L. N88-29654
SHAW, J. A. N88-29316
SHELLAN, JEFFREY N88-29186
SHELNUTT, J. A. N88-29043
SHEN, S. C. N88-29610
SHEN, Y. N88-29011
SHESTOPALOV, V. P. N88-29056
SHIFLET, G. J. N88-29011
SHINAR, J. N88-29498
SHINN, N. O. N88-29578
SHIVA, S. G. N88-29354
SHORT, LAWRENCE O. N88-29286
SHRAIRMAN, RUTH N88-29470
SILBERMANN, FRANK S. N88-29341
N88-29488
SIMON, P. C. N88-29228
N88-29709
SIMONDS, CHARLES H. N88-29044
SIMONSEN, L. N88-29293
SIMS, GARY R. N88-29992
N88-29993
SINGER, R. B. N88-29692
N88-29696
SINGER, ROBERT N88-29655
SINGH, JAG J. N88-29002
SINGH, P. N88-29629
SINGH, SUNIL KUMAR N88-29175
SIRENKO, YU. K. N88-29056
SISK, ROBERT C. N88-29602
SKILLMAN, THOMAS L., JR. N88-29386
SLEMROD, M. N88-29103
SLEMROD, MARSHALL N88-29506
SMELTZER, DONALD B. N88-28918
SMITH, ARLYNN W. N88-28973
SMITH, MAILE E. N88-29495
SMITH, MILTON O. N88-29655
SMITH, P. D. N88-29129
SMITH, R. N88-29568
SMITH, ROBERT E. N88-29316
SMITH, RONALD C. N88-28918
SMITH, WILLIAM T. N88-29499
SMRCINA, KURT L. N88-29177
SNOOK, THOMAS E. N88-28951
SOBIECZKY, HELMUT N88-29322
SOENTGERATH, W. N88-29073
N88-29074
SOJKA, P. E. N88-29924
SOLOMON, S. C. N88-29654
SOMS, ANDREW P. N88-29331
N88-29485
SORENSEN, HAROLD C. N88-29485
SORENSON, REESE L. N88-29315
SPERLING, GEORGE N88-29288

SPINDLER, R. N88-29031
SPRANGLE, PHILLIP N88-29160
SPRINKLE, DANNY R. N88-29002
SQUYRES, S. W. N88-29671
SRINIVASAMURTHY, KANDURU N. N88-28952
SRINIVASAN, S. N88-29420
STACHOWITZ, ROLF A. N88-29416
STAHL, DAVID J., JR. N88-28940
STANEWSKY, E. N88-28870
N88-28873
STARK, EUGENE W. N88-29333
STASIEWICZ, K. N88-29244
STATMAN, JOSEPH I. N88-29076
STEENKEN, W. G. N88-28929
STEFFES, PAUL G. N88-29653
STEGER, J. L. N88-29313
STEINBRENNER, J. P. N88-29317
STEINHOFF, JOHN N88-29320
STENGER, GREGORY J. N88-29034
STERNBERG, SAUL N88-29290
STESLICKA, M. N88-29604
STOHL, F. V. N88-29043
STOUT, WILLIAM N88-29483
STOVALL, T. K. N88-28960
STRAUSS, ALVIN M. N88-29376
STROBELL, M. E. N88-29682
STUMP, WILLIAM R. N88-28944
STUTZ, R. A. N88-29638
SU, ZHAOBIN N88-29035
SUCHTING, STEVEN N88-29410
SUCHTING, STEVEN A. E. N88-29387
SUENAGA, M. N88-29572
SUHS, N. E. N88-29324
SULEIMAN, SALEM A. N88-29380
SUN, TZE-CHIEN N88-29486
SUNDARAIYER, VANI N88-29355
SUNDARARAGHAVAN, K. R. N88-29420
SUNG, NAK-HO N88-29033
SUPPLEE, FRANK H., JR. N88-29145
SUREK, T. N88-29220
SUSKO, MICHAEL N88-29256
SWANSON, E. R. N88-29802
SWEEDLER, JONATHAN V. N88-28992
N88-28993
SWOLINSKY, MANFRED N88-28900
SZODRUCH, J. N88-28860
SZTIPANOVITS, J. N88-29371
N88-29390
SZULGA, JERZY N88-29460

T

TA, HONG NGAT N88-29608
TADA, EISUKE N88-29589
TAKABATAKE, TOSHIRO N88-29588
TAKASE, KUNIKATSU N88-29183
TAKESI, SAITO N88-29627
TALLEY, T. L. N88-29554
TANAKA, KENNETH L. N88-29668
N88-29681
N88-29690
N88-29695
TANG, CHA-MEI N88-29160
TANG, JANE S. N88-29237
TANIMOTO, DOUGLAS N88-29166
TARJAN, ROBERT E. N88-29345
N88-29346
N88-29347
N88-29348
N88-29468
N88-29469
N88-29470
N88-29471
TASK, H. LEE N88-29294
N88-29298
TATRY, M. B. N88-29128
TAUBER, G. E. N88-29507
TAVERA, GERARD N88-29134
TAYLOR, G. N88-29613
TEIGELER, EDWARD F. N88-29500
TEIXEIRA, A. F. F. N88-29622
TEJWANI, M. J. N88-29087
TEOH, W. N88-29379
TEOH, WILLIAM N88-29408
THEILHABER, K. N88-29553
THOMAS, MITCHEL E. N88-29259
N88-29260
N88-29261
THOMPSON, D. S. N88-28965
THOMPSON, JOE F. N88-29321
THOMPSON, JOHN R. N88-28973
THOMPSON, JOSEPH F. N88-29313
THOMPSON, ROBERT L. N88-29195
THOMPSON, T. W. N88-29697
THORNBRUGH, ALLISON N88-29414
TIMMINS, S. P. N88-29225
TITLE, A. M. N88-29708
TODD, J. A. N88-28981
TODOROV, T. D. N88-29503
TOK, MEHMET K. N88-29065
TOMITA, KENJI N88-29642
TOMIYAMA, KEN N88-29236
TOTH, R. P. N88-29084
TRAD, LAURIE A. N88-29272
TREIMAN, ALLAN H. N88-29698
TREIMAN, S. N88-29529
TRUONG, TRIEU-KIE N88-28946
TSAI, LIAN CHENG N88-29362
TSAO, S. S. N88-29082
TSENG, C. N88-29018
TSENG, J. B. N88-28891
TURNBERG, J. N88-28928
TURNER, GREGORY A. N88-29599
TURNER, KENNETH C. N88-29649

U

UCHIMOTO, E. N88-29559
UDAGAWA, AKIRA N88-29023
UHLMANN, D. R. N88-29037
ULLOA, S. E. N88-29587
UNDERWOOD, J. H. N88-29463
UNTERRAINER, KARL N88-29601

V

VACHTSEVANOS, G. N88-29395
VANBRUNDT, H. E. N88-29061
VANDENBULCK, ERIC N88-29458
VANDERSIJP, C. C. E. N88-29021
VANDERVEEKEN, JOSEPHUS PETRUS MARIA
N88-29615
VANDOMMELEN, L. N88-28886
VANGULIK, M. N88-29065
VANINGEN, J. L. N88-28874
VANLAETHEM-MEUREE, N. N88-29228
VANRIJSWIJK, WILLEM N88-29534
VANVELZEN, GERARDUS DOMINICUS FREDERIKUS
N88-29532
VARSHNEY, P. K. N88-29438
VARSHNEY, PRAMOD K. N88-29448
VARSI, GIULIO N88-29352
VASUDEVAN, M. S. N88-29522
VENTURINI, E. L. N88-29578
VERMES, DOMOKOS N88-29442
VERMEULEN, GERARDUS ARNOLDUS N88-29001
VERRIEST, E. I. N88-29462
VIDYASAGAR, M. N88-29439
VIEILLEFOND, H. N88-29282
VIJAYKUMAR, RAMAKRISHNAN N88-29170
VILLARREAL, JAMES A. N88-29397
VINZ, F. N88-29360
VINZ, FRANK L. N88-29367
VOLOSHIN, M. V. N88-29705
VONDADELZSON, MICHAEL N88-29094
VONLAVANTE, E. N88-28882
VONWINTERFELD, CHR. N88-29073
VOORHOEVE, JOHANNES CORNELIS N88-29533
VYSOTSKIJ, M. I. N88-29705

W

WADE, J. E. N88-29211
WAGH, A. S. N88-29188
WAGNER, A. N88-29563
WAKATANI, M. N88-29550
WALGAMOTT, CARY M. N88-28910
WALKER, A. B. N88-29479
WALKER, BRUCE K. N88-29185
WALKER, C. T. N88-29153
WALKER, S. N. N88-29211
WALSH, P. A. N88-29699
WALSH, PATTI A. N88-29659
WANG, A. S. N88-28968
WANG, CAROLINE K. N88-29411
WANG, F. X. N88-29202
WANG, LUI N88-29397
N88-29400
WANG, VICTOR N88-29547
WANG, YONGLIANG N88-29573
WARD, JOHN M. N88-29203
WARK, J. S. N88-29579
WARMING, ROBERT F. N88-29455
WASHINGTON, PAUL ALLYN N88-29229
WATANABE, YASUSHI N88-29588
WATSON, R. T. N88-29233
WEATHERILL, N. P. N88-29316
WEBB, STEPHEN G. N88-28931
WEBER, EDWARD J. N88-29237
WEBER, H. W. N88-29584
WEE, WILLIAM G. N88-29362
WEEKS, DAVID J. N88-29375
WEHREY, M. N88-29212
WEIDNER, JULIUS N88-29245
WEINBERG, BERNARD C. N88-29110
WEINSTEIN, LEONARD M. N88-29149
N88-29150
WEISER, N. N88-29123
WELCH, D. I. N88-29266
WELLS, JOHN KIMBERLEY N88-29206
WERELEY, NORMAN M. N88-29185
WERKHEISER, ANNE N88-29140
WERNET, MARK P. N88-29152
WERTZ, D. W. N88-28996
WESSELSKI, CLARENCE J. N88-28958
N88-29180
N88-29181
WESSLING, FRANCIS N88-29408
WEST, C. L. N88-29549
WEST, MICHAEL JOHN N88-29648
WHANGBO, M. H. N88-29585
WHERRY, DAVID N88-29210
WHITE, G. S. N88-29016
WHITE, O. R. N88-29709
WHITESIDES, GEORGE M. N88-28991
WHITLOCK, R. R. N88-29579
WHITTEN, ALAN N88-29355
WIESE, MICHAEL R. N88-29318
WIGLEY, DAVID A. N88-28933
WILHELMS, D. E. N88-29700
WILKINSON, DAVID ADAM N88-29645
WILLIAMS, MICHAEL K. N88-29555
WILLIAMS, R. N88-29371
N88-29390
WILLIAMSON, S. J. N88-29275
WILLIAMSON, SAMUEL J. N88-29143
N88-29278
WILLIS, PAUL A. N88-29444
WILLIS, ZDENKA S. N88-29068
WILSON, A. M. N88-29016
WILSON, LIONEL N88-29688
WINCHELL, PHILIP J. N88-29681
WINKLER, S. N88-29020
WINOKUR, P. S. N88-29082
WISEMAN, S. R. N88-29308
WISEMBERG, J. N88-29228
WLEZIEN, RICHARD W. N88-28889
WOIGNIER, T. N88-29038
WOOD, CHARLES N88-29151
WOODRUFF, STEPHEN LAURENCE N88-29102
WOODWARD, P. R. N88-29329
WORKMAN, GARY L. N88-29361
WORONOW, A. N88-29701
WU, KE N88-29627
WU, YUEHUA N88-29490
WU, ZHONGLIANG N88-29664
WUERMSEER, M. N88-28963
WYGNANSKI, I. N88-28994
WYNDHAM, B. A. N88-28906
WYNNE, ELEANOR C. N88-28895

X

XU, WENLAN N88-29610
XU, YOUWEN N88-29572
XU, ZHENGYI N88-29609
N88-29612
XU, ZHI-YUE N88-28981

Y

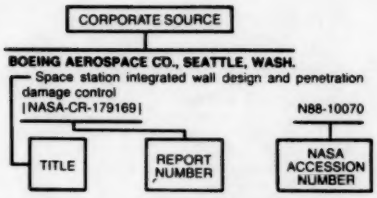
YAMASAKI, H. N88-29087
YAMAZAKI, TOSHIMITSU N88-29588
YANG, HUAQUANG N88-29612
YASHINA, N. P. N88-29056
YOEL, RAYMOND R. N88-29417
YOSHIHARA, H. N88-29313
N88-29314
YOST, WILLIAM T. N88-29012
YOUNG, ANDREW J. N88-29281
YU, KAI F. N88-29491
YU, LU N88-29035
YUCE, HAKAN HURSIT N88-29193

Z

ZABUSKY, N. J. N88-29117
ZAGORSKI, M. N88-29604
ZAHAVI, J. N88-29090
ZAK, B. D. N88-29230
ZANETTI, L. J. N88-29244
ZAWISLAK, F. C. N88-28999
ZENT, A. P. N88-29688
N88-29702

ZHANG, JINDONG N88-29191
ZHANG, YUANZHONG N88-29650
ZHENG, CHINGFA N88-29135
ZHONG, U. N88-28968
ZHOU, SHIXUN N88-29606
ZHU, MEIFANG N88-29609
ZHU, YUN N88-29606
ZIEMKE, M. CARL N88-29406
ZIMBELMAN, J. R. N88-29654
ZIMBELMAN, JAMES R. N88-29703
ZIOLKOWSKI, RICHARD N88-29511
ZIONTS, STANLEY N88-29336
ZOCHER, E. N88-29073
N88-29075
ZOCHER, M. A. N88-29638
ZSOLT, G. N88-29605
ZUSHI, H. N88-29550
ZYDA, MICHAEL J. N88-28940

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENCES OF THE UKRAINIAN SSR, KHARKOV.
Qualitative characteristics of open waveguide resonator spectra
[DE88-702387] N88-29056
Apparatus for submillimeter laser diagnostics of high-temperature plasma
[DE88-702464] N88-29563

ADMIRALTY RESEARCH ESTABLISHMENT, TEDDINGTON (ENGLAND).
Solution of large order Fourier-Bessel equations
[ARE-TM(UHA)-88504] N88-29475

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
Boundary layer simulation and control in wind tunnels
[AGARD-AP-224] N88-28857
Aerodynamic data accuracy and quality: Requirements and capabilities in wind tunnel testing
[AGARD-AR-254] N88-28893
AGARD engine disc cooperative test programme
[AGARD-R-766] N88-28926
Visual Effects in the High Performance Aircraft Cockpit
[AGARD-LS-156] N88-29291
Three dimensional grid generation for complex configurations: Recent progress
[AGARD-AG-309] N88-29313

AEG-TELEFUNKEN, WEDEL (WEST GERMANY).
Solar dynamic power systems
[ETN-88-92969] N88-29224

AEROJET ELECTROSYSTEMS CO., AZUSA, CALIF.
Space-charge-wave solid state microwave amplifier
[AD-A193792] N88-29091

AEROJET STRATEGIC PROPULSION CO., SACRAMENTO, CALIF.
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 1
[NASA-CR-178973] N88-28964
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system
[NASA-CR-178974] N88-28965

AERONAUTICAL RESEARCH INST. OF SWEDEN, STOCKHOLM.
A calculation of the turbulent boundary layer on a slender ellipsoid at low incidence
[FFA-TN-1988-02] N88-29126
ASKA-acoustics: Theory and applications
[FFA-TN-1988-13] N88-29519
Analysis of the transmission of sound into the passenger compartment of a propeller aircraft using the finite element method
[FFA-TN-1988-15] N88-29520
Overview of computational vibro acoustics. State of the art and future development
[FFA-TN-1988-17] N88-29521

AEROSPACE CORP., EL SEGUNDO, CALIF.
Thin film-residual stress assessment
[AD-A193205] N88-29018
Measurements of XeF (Xenon Fluoride) ground state dissociation and vibrational equilibration
[AD-A194611] N88-29527

AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
Vision through aircraft transparencies N88-29294
Night lighting and night vision goggle compatibility N88-29297
Display system image quality N88-29298

AIR COMMAND AND STAFF COLL., MAXWELL AFB, ALA.
A numerical study of the test time in a hypersonic shock tunnel
[AD-A194057] N88-28888
Flight information publication (FLIP) feedback
[AD-A194462] N88-28897
Inflight rearming
[AD-A193564] N88-28909
Low altitude: A new dimension in air refueling
[AD-A193819] N88-28910
Computers in weapons systems: A look at the F-15
[AD-A194498] N88-28920
The Soviet MIR space station
[AD-A194040] N88-28951
Future air-to-air training for the RF-4
[AD-A194363] N88-29284
Proposed improvements to the USAF flight screening program
[AD-A194506] N88-29285
ADP (Automated Data Processing) requirements definition and documentation through user-developed prototypes
[AD-A194407] N88-29332
SSTS (Space Surveillance and Tracking System): The importance of early test and evaluation organizational participation
[AD-A193745] N88-29499
The principles of mass and maneuver applied to space operations
[AD-A194037] N88-29500

AIR FORCE ASTRONAUTICS LAB., EDWARDS AFB, CALIF.
Anti-aliasing filters for dynamics and control experiments
[AD-A193758] N88-29203

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MASS.
Filling of the atmospheric transmission window due to emission from very high rotational levels of NO and O3
[AD-A194670] N88-29239
Wave structures in thermospheric density from satellite electrostatic triaxial accelerometer measurements
[AD-A194134] N88-29240

AIR FORCE HUMAN RESOURCES LAB., BROOKS AFB, TEX.
Validity of the academic aptitude composite of the Air Force Officer Qualifying Test (AFOQT)
[AD-A194753] N88-29286

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
Performance of GPS-aided INS during high-dynamic maneuvers
[AD-A194624] N88-28903
Time periodic control of a multi-blade helicopter
[AD-A194435] N88-28931
LRS-2: A specialized knowledge system for launch resource scheduling
[AD-A194625] N88-28941
Automatic classification of digitally modulated signals
[AD-A194623] N88-29064
A performance study of the hypercube architecture
[AD-A194361] N88-29433
An analysis of heat transfer after loss of primary coolant in the SP-100 reactor system
[AD-A194619] N88-29539

AIR FORCE WEAPONS LAB., KIRTLAND AFB, N. MEX.
Frequency doubling at 1.315 micrometers
[AD-A193902] N88-29092
Preliminary studies of NF3+H2 production of N2(A3 sigma(+)u) in a supersonic flow
[AD-A194479] N88-29162
N2(A3epsilon u+) by reaction of N2F4+H2 in a supersonic flow
[AD-A194493] N88-29163

AIRCRAFT RESEARCH ASSOCIATION LTD., BEDFORD (ENGLAND).
Experimental tools: The tunnel and the model N88-28864
Transport-type configurations N88-28867
Combat aircraft N88-28868
Component adaptive grid generation for aircraft configurations N88-29316

AKRON UNIV., OHIO.
Elastic behavior of a rubber layer bonded between two rigid spheres
[AD-A193698] N88-29030
Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure. Part 1: Theory
[NASA-CR-179886] N88-29480

ALABAMA A & M UNIV., HUNTSVILLE.
A relational data-knowledge base system and its potential in developing a distributed data-knowledge system N88-29353
Issues on the use of meta-knowledge in expert systems N88-29357

ALABAMA UNIV., BIRMINGHAM.
A flexible search strategy for production systems N88-29420

ALABAMA UNIV., HUNTSVILLE.
Hologram representation of design data in an expert system knowledge base N88-29354
An expert system for reliability modeling N88-29355
A knowledge-based decision support system for payload scheduling N88-29358
Optimization of low gravity materials processing experiments using expert systems N88-29361
Expertise and reasoning with possibility: An explanation of modal logic and expert systems N88-29363
Automatic object recognition N88-29368
OMV docking simulator N88-29379
Knowledge based programming environments: A perspective N88-29393
Life-span knowledge engineering for space operations N88-29401
Personnel occupied woven envelope robot N88-29408

ALASKA UNIV., FAIRBANKS.
Stratigraphy of the Kasei Valles region, Mars N88-29690

AMSTERDAM UNIV. (NETHERLANDS).
Dispersion effects in elastic electron scattering from C12
[B8805297] N88-29536

ANALEX CORP., CLEVELAND, OHIO.
A statistical rain attenuation prediction model with application to the advanced communication technology satellite project. 1: Theoretical development and application to yearly predictions for selected cities in the United States
[NASA-CR-179498] N88-29077

ANALYSAS CORP., OAK RIDGE, TENN.
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-008368] N88-29225

ANAMET LABS., INC., HAYWARD, CALIF.
Interactive plotting of NASTRAN aerodynamic models using NPLOT and DISSPLA
[AD-A194115] N88-29204

APPLIED CRYOGENICS AND MATERIALS CONSULTANTS, INC., HAMPTON, VA.
Technology for pressure-instrumented thin airfoil models
[NASA-CR-4173] N88-28933

APTECH ENGINEERING SERVICES, INC., SUNNYVALE, CALIF.
Stress intensity factors for cracked metallic structures under rapid thermal loading
[AD-A191219] N88-29004
ARGONNE NATIONAL LAB., ILL.
Stability control of leakage flow channels
[DE88-009995] N88-29107
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432
Bootstrap currents in radio-frequency-driven tokamak equilibria
[DE88-011136] N88-29561
Preparation of superconducting YBa2Cu3O(sub 7-x) films by magnetron sputtering
[DE88-009977] N88-29583
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
Argonne National Laboratory technology transfer report, FY87
[DE88-010091] N88-29639
ARIZONA STATE UNIV., TEMPE.
Avionic expert systems N88-29365
Photogeological inferences of Martian surface composition N88-29675
ARIZONA UNIV., TUCSON.
Applications of charge transfer devices in spectroscopy
[AD-A194408] N88-28992
High performance charge transfer device detectors
[AD-A194409] N88-28993
Polymerization of azaethylenes (imines) and aza-1,3-dienes: Potential reactive monomers
[AD-A194717] N88-29028
Molecular fluorescence measurements with a charge-coupled device detector
[AD-A194437] N88-29141
The surface composition of Mars from earthbased observations N88-29696
ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, WATERVLIET, N.Y.
Design of a feeling-thinking machine
[AD-A194107] N88-29448
ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND, WATERVLIET, N. Y.
A technique for measuring area under a curve
[AD-A193559] N88-29483
An adaptive overlapping local grid refinement method for two-dimensional parabolic systems
[AD-A193560] N88-29484
ARMY COMBINED ARMS CENTER, FORT LEAVENWORTH, KANS.
The problem of space in Soviet operational art
[AD-A194150] N88-29502
ARMY CONCEPTS ANALYSIS AGENCY, BETHESDA, MD.
An algorithm for determining the location of points in computer simulations
[AD-A193713] N88-29343
ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.
A comparison: Static and future kinematic GPS (Global Positioning System) surveys
[AD-A194556] N88-28904
Determining vehicle motion from stereo image sequences
[AD-A194371] N88-29140
ARMY MATERIEL COMMAND, TOBYHANNA, PA.
Procedures for identification and handling of Printed Circuit Boards (PCBs)
[AD-A191177] N88-29078
ARMY RESEARCH INST. OF ENVIRONMENTAL MEDICINE, NATICK, MASS.
Low doses of atropine sulfate impair retention of a well-learned spatial task
[AD-A194065] N88-29266
Human performance and acute hypoxia, chapter 12
[AD-A192604] N88-29270
Effects of psychophysical lifting training on maximal repetitive lifting capacity
[AD-A192605] N88-29271
Alterations in upper extremity motor function in soldiers during acute high altitude exposure
[AD-A192676] N88-29272
Attitudes towards the cold: Effects on psychological mood and subjective reports of illness during cold weather training
[AD-A194777] N88-29274
Gastric emptying during walking and running: Effects of varied exercise intensity
[AD-A194025] N88-29281
Nutrient requirements for high stress environments
[AD-A194595] N88-29301
ARMY WAR COLL., CARLISLE BARRACKS, PA.
SDI (Strategic Defense Initiative). Where do we go from here
[AD-A194544] N88-29497
ARNOLD ENGINEERING DEVELOPMENT CENTER, ARNOLD AIR FORCE STATION, TENN.
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
Comparison of 2-D Fourier and spatial techniques for removing noise in real-time X-ray radiography
[AD-A193700] N88-28962
ASSOCIACAO BRASILEIRA DE CIENCIAS MECANICAS, RIO DE JANEIRO.
Kinetic of martensitic transformations induced by hydrogen in the austenite
[DE88-701623] N88-29007
Qualification of expansion and welding procedures of tube-to-tubesheet joints for heat exchangers in nuclear power plants
[DE88-701621] N88-29174
Elastic-plastic analysis of part-through crack propagation in piping and pressure vessels
[DE88-701619] N88-29198
ATOMINSTITUT DER OESTERREICHISCHEN HOCHSCHULEN, VIENNA.
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584
AVIONS MARCEL DASSAULT-BREGUET AVIATION, SAINT-CLOUD (FRANCE).
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535

B

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
Combustion studies of acoustically suspended liquid droplets
[AD-A193892] N88-28998
Computational fluid dynamics methods for low Reynolds number precessing/spinning incompressible flows
[AD-A193891] N88-29119
Polynomial definition of discrete field points of map of diffusion equation, part 1
[AD-A193697] N88-29467
BATTELLE COLUMBUS LABS., OHIO.
Evaluation of transfer films of Salox M on 440C for HPOTP bearing cage applications, task 119
[NASA-CR-179020] N88-29184
BATTELLE INST., FRANKFURT AM MAIN (WEST GERMANY).
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
BDM CORP., HUNTSVILLE, ALA.
Analyst-centered models for systems design, analysis, and development N88-29364
BEGELEIDINGSCOMMISSIE REMOTE SENSING, DELFT (NETHERLANDS).
Activities report in remote sensing
[ETN-88-92905] N88-29714
BERKELEY RESEARCH ASSOCIATES, INC., CALIF.
Modeling of atomic processes in X-ray laser plasmas
[AD-A194118] N88-29567
BETA POWER, INC., WAYNE, PA.
Considerations and measurements of latent-heat-storage salts for secondary thermal battery applications
[DE88-011091] N88-29213
BOEING AEROSPACE CO., HUNTSVILLE, ALA.
A plan for time-phased incorporation of automation and robotics on the US space station N88-29377
A robotic system for automation of logistics functions on the Space Station N88-29407
Remote servicing of space systems N88-29409
A teleoperated robotic manipulator system for materials processing experiment servicing N88-29410
A nonlinear filtering process diagnostic system for the Space Station N88-29417
BOEING AEROSPACE CO., SEATTLE, WASH.
A space station onboard scheduling assistant N88-29402
BOEING CO., SEATTLE, WASH.
Distributed cooperating processes in a mobile robot control system N88-29386
BOEING COMMERCIAL AIRPLANE CO., SEATTLE, WASH.
Variable Sweep Transition Flight Experiment (VSTFE)-parametric pressure distribution boundary layer stability study and wing glove design task
[NASA-CR-3992] N88-28894
BOEING COMPUTER SERVICES CO., SEATTLE, WASH.
Motion planning for a free-flying robot N88-29378
BOEING COMPUTER SUPPORT SERVICES, INC., HUNTSVILLE, ALA.
Failure modes and effects analysis automation N88-29370
Generic supervisor: A knowledge-based tool for control of space station on-board systems N88-29389
BOEING MILITARY AIRPLANE DEVELOPMENT, SEATTLE, WASH.
Lessons learned in the mesh generation for PN/S calculations N88-29314
BOEING MILITARY AIRPLANE DEVELOPMENT, WICHITA, KANS.
Multiple-Purpose Subsonic Naval Aircraft (MPSNA): Multiple Application Propfan Study (MAPS)
[NASA-CR-175104] N88-28917
BOSTON COLL., CHESTNUT HILL, MASS.
Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field N88-29551
BOSTON UNIV., MASS.
Crystal fractionation in the SNC meteorites: Implications for surface units on Mars N88-29698
BRITISH AEROSPACE PUBLIC LTD. CO., WEYBRIDGE (ENGLAND).
Complex configurations N88-28861
Development and analysis of turbulent non-equilibrium boundary layers N88-28872
BRITISH PETROLEUM CO. LTD., LONDON (ENGLAND).
Leaf spring
[GB-PATENT-2-192-689-A] N88-29179
Testing degradation of a sample under thermal cycling
[GB-PATENT-2-188-163-A] N88-29206
BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Effects of metal substitutions (Fe and Ga) in YBa2Cu3O7 on its superconducting properties and microstructures
[DE88-007393] N88-29572
Conductor loss in superconducting power transmission cables
[DE88-011414] N88-29588
BROWN UNIV., PROVIDENCE, R. I.
Development and experimental verification of a two-dimensional numerical model of piezoelectrically induced threshold voltage shifts in GaAs MESFETs
[AD-A193462] N88-29080
Results on the influence of crack tip plasticity during dynamic crack growth
[AD-A193460] N88-29194
Critical conditions for failure in materials subjected to high rates of loading
[AD-A194697] N88-29201
Convex duality approach to the optimal control or diffusions
[AD-A194535] N88-29442
Minimizing escape probabilities: A large deviations approach
[AD-A194534] N88-29496
Shear stress at a film-substrate interface due to mismatch strain
[AD-A193461] N88-29577
Distribution and timing of thick transient air-fall deposits in Electris: Implications for the nature of the upland plains N88-29674
Origin of SNC kaersutitic amphibole: Experimental data N88-29693
Early cratering rates and the nature of the Martian cratered uplands N88-29694

C

CALIFORNIA INST. OF TECH., PASADENA.
Intraplate deformation, stress in the lithosphere and the driving mechanism for plate motions
[NASA-CR-183121] N88-29231
Seismic reflection experiments imaging the physical nature of crustal structures in southern California N88-29235
CALIFORNIA UNIV., BERKELEY.
Computer systems for the representation and manipulation of mathematical knowledge
[AD-A193547] N88-29340
Vortex formation and particle transport in a cross-field plasma sheath
[DE88-008931] N88-29553
Collector and source sheaths of a finite ion temperature plasma
[DE88-008934] N88-29564
Plasma theory and simulation
[AD-A194674] N88-29565
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Real-time measurements of the size fractionation of ambient black carbon aerosols at elevated humidities
[DE88-010870] N88-29138

Unstable heat pipes
[DE88-010780] N88-29217
Measurements of vacuum arc ion charge state distributions
[DE88-006249] N88-29558
Potential induced structural transformations of the Au(100) and Au(111) surfaces
[DE88-005446] N88-29571
High-T(sub c) superconductor and its use in superconducting magnets
[DE88-006403] N88-29581

CALIFORNIA UNIV., LOS ANGELES.
The interaction of Io with the plasma torus N88-29704

CALIFORNIA UNIV., SAN DIEGO, LA JOLLA.
Spectral reflectance of SNC meteorites: Relationships to Martian surface composition N88-29683

CALSPAN FIELD SERVICES, INC., ARNOLD AFS, TENN.
Vortex flows N88-28875
Boundary layer manipulation N88-28877
Experience with three dimensional composite grids N88-29324

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
Combustion dynamics and thermal structure of a planar spray flame N88-28985

CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.
Hierarchical structure in polymeric solids and its influence on properties
[AD-A194720] N88-29029

CENTERS FOR DISEASE CONTROL, ATLANTA, GA.
Quality control in microbiology: CDC lab manual
[PB88-179890] N88-29263

CENTRE D'ESSAIS EN VOL, ISTRES (FRANCE).
Variation of carotid flow under load, studied by the Doppler echo method
[REPT-1149] N88-29282

CENTRE D'ETUDES ET DE RECHERCHES, TOULOUSE (FRANCE).
Microwave frequency nondestructive control
[CERT-2/1355-MO] N88-28976
Study of hypersonic boundary layers
[CERT-RSF-OA-17/5005-AYD] N88-29121
Electrical conductivity of GaAs layers implanted on semi-insulator nondoped substrates
[CERT-422000/RF] N88-29614

CENTRO BRASILEIRO DE PESQUISAS FISICAS, RIO DE JANEIRO.
On the distribution equations
[DE88-702217] N88-29454
On the quantization of constrained generalized dynamics
[DE88-702223] N88-29505
Weak interaction physics: From its birth to the electroweak model
[DE88-702494] N88-29531
Time travel in the homogeneous Som-Raychaudhuri universe
[DE88-702220] N88-29622
Hadrons produced in atmospheric interactions
[DE88-702492] N88-29712

CENTRO DI CULTURA SCIENTIFICA A. VOLTO, COMO (ITALY).
Chaotic behaviour in quantum dynamics
[AD-A193936] N88-29623

CERAMATEC, INC., SALT LAKE CITY, UTAH.
Development of planar geometry solid oxide fuel cell technology, phase 1
[PB88-210356] N88-29215

CHEMICAL DYNAMICS CORP., UPPER MARLBORO, MD.
Theoretical investigations of nitrocubane decomposition
[AD-A194556] N88-29047

CHRYSLER CORP., NEW ORLEANS, LA.
Space shuttle phase B wind tunnel model and test information. Volume 2: Orbiter configuration
[NASA-CR-178415-VOL-2-PT-1] N88-28881

CINCINNATI UNIV., OHIO.
Direct-solution techniques for viscous flows and their control
[AD-A194775] N88-29114
Approximate evaluation of semi-Markov chain reliability models
[AD-A194669] N88-29185
An approach to combining heuristic and qualitative reasoning in an expert system N88-29362

CITY UNIV. OF NEW YORK, N.Y.
Resonance excitation of linear and non-linear spiral density waves in a gaseous disk N88-29643

CIVIL AVIATION AUTHORITY, LONDON (ENGLAND).
Smoke hoods: Net safety benefit analysis
[CAA-PAPER-87017] N88-28898
UK airmisses involving commercial air transport
[CAA-1/88] N88-28907

CK CONSULTANTS, INC., MARIPOSA, CALIF.
Avionics system design for high energy fields: A guide for the designer and airworthiness specialist
[NASA-CR-181590] N88-28919

COAST GUARD, ALEXANDRIA, VA.
Indian Ocean validation
[AD-A194458] N88-28902

COLORADO UNIV., BOULDER.
Elastic wave dispersion in laminated composite plate
[AD-A192289] N88-28967
Some learnability results for analogical generation
[AD-A193669] N88-29342
The FORCE
[AD-A193463] N88-29429
Programming language concepts for multiprocessors
[AD-A193465] N88-29430

COLUMBIA UNIV., NEW YORK, N.Y.
Topics in adaptive control and inference
[AD-A194718] N88-29443

COMISION NACIONAL DE ENERGIA ATOMICA, BUENOS AIRES (ARGENTINA).
Phenomena of the ionic transport in the stress corrosion of metals
[DE88-702502] N88-29013

COMMUNICATIONS RESEARCH CENTRE, OTTAWA (ONTARIO).
The 44/20 GHz ground terminal
[AD-A194002] N88-29069

COMPUTATIONAL MECHANICS CO., AUSTIN, TEX.
Adaptive computational methods for aerothermal heating analysis
[NASA-CR-181636] N88-29115

COMPUTER RESOURCES INTERNATIONAL A/S (DENMARK).
Investigation of the use of High Order Languages (HOLs) for on-board software
[CRI/FR/HOL-C/1/87] N88-29349

COMPUTER SCIENCES CORP., HUNTSVILLE, ALA.
NOA: A Network Operator Assistant for scheduling Tracking and Data Relay Satellite System (TDRSS) N88-29403

CONNECTICUT UNIV., STORRS.
Mechanics of thrust fault formation N88-29229
Human auditory and visual continuous evoked potentials N88-29269
Dynamically reconfigurable distributed database systems
[AD-A194716] N88-29636

CONRAD TECHNOLOGIES, INC., KING OF PRUSSIA, PA.
Structural dynamics of maneuvering aircraft
[AD-A192376] N88-28908

CORNELL UNIV., ITHACA, N.Y.
Dissolution rates of polymers and copolymers based on methyl, ethyl and butyl methacrylate
[AD-A194713] N88-29027
Motion planning with obstacles and dynamic constraints N88-29175
Distortion estimates for negative Schwarzian maps
[AD-A193172] N88-29209
Experiments in automatic phrase indexing for document retrieval: A comparison of syntactic and non-syntactic methods N88-29634

CREW SYSTEMS CONSULTANTS, YELLOW SPRINGS, OHIO.
Improvement of head-up display standards. Volume 2: Evaluation of head-up displays to enhance unusual attitude recovery
[AD-A194601] N88-28921
Improvement of head-up display standards. Volume 5: Head up display ILS (Instrument Landing System) accuracy flight tests
[AD-A194602] N88-28922

D

DARTMOUTH COLL., HANOVER, N.H.
Emetic mechanism in acute radiation sickness
[AD-A194102] N88-29267
Intercrater plains deposits and the origin of Martian valleys N88-29661

DAYTON UNIV., OHIO.
An integral equation for the linearized unsteady supersonic flow over a wing
[AD-A193773] N88-28887
Molecular composites processing and properties, 1
[AD-A194113] N88-28974
A study of the floating roller peel test for adhesives
[AD-A194114] N88-29034
Plastic flow and failure modeling under high strain rate loading
[AD-A194223] N88-29199

DELAWARE UNIV., NEWARK.
An investigation of some basic properties of hybrid composite materials
[AD-A194136] N88-28975

DENVER UNIV., COLO.
PLZT (Lead-Lathanium-Zirconium-Titanium) electro-optic photographic system
[AD-A193473] N88-29137

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (WEST GERMANY).
Estimation of aircraft parameters using filter error methods and extended Kalman filter
[DFVLR-FB-88-15] N88-28911
Grid generation around transport aircraft configurations using a multi-block structured computational domain N88-29325

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE (WEST GERMANY).
The influence of numerical boundary conditions on transonic flow
[DFVLR-FB-88-06] N88-28890
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN (WEST GERMANY).
Introduction and critical flow phenomena N88-28870
Shock boundary layer interaction N88-28873
European research program on viscous flows
[DFVLR-AVA-IB-227-87-A-15] N88-29129
Analytical surfaces and grids N88-29322

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (WEST GERMANY).
On the collision hazard of colocated geostationary satellites
[DFVLR-FB-88-02] N88-28952
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 1: Atomic ions (H(+), He(+), N(+), O(+))
[DFVLR-FB-88-11-PT-1] N88-29241
A model of the ionosphere in the altitude interval 50 to 4000 km. Part 2: Molecular ions (N2(+), NO(+), O2(+)) and electron density
[DFVLR-FB-88-12-PT-2] N88-29242

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, STUTTGART (WEST GERMANY).
Crash simulation calculations and component idealization for an airframe. Computer code KRASH 79
[ETN-88-92971] N88-28899
Solar dynamic power systems
[ETN-88-92969] N88-29224

DIGITAL EQUIPMENT CORP., ATLANTA, GA.
AI tools in computer based problem solving N88-28424
An expert system for natural language processing N88-28426
Expert system technology as a data processing tool N88-29427

DORNIER-WERKE G.M.B.H., FRIEDRICHSHAFEN (WEST GERMANY).
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Solar dynamic power systems
[ETN-88-92969] N88-29224
Mesh generation for industrial application of Euler and Navier Stokes solvers N88-29323
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535

DORNIER-WERKE G.M.B.H., OBERPFAFFENHOFEN (WEST GERMANY).
Development of a glass fiber wing following the construction regulation FAR Part 23
[ETN-88-92966] N88-28979

DOUGLAS AIRCRAFT CO., INC., LONG BEACH, CALIF.
Critical joints in large composite primary aircraft structures. Volume 2: Technology demonstration test report
[NASA-CR-172587] N88-28915

Critical joints in large composite primary aircraft structures. Volume 3: Ancillary test results
[NASA-CR-172588] N88-28916
Critical joints in large composite primary aircraft structures. Volume 1: Technical summary
[NASA-CR-3914] N88-28983
DRAPER (CHARLES STARK) LAB., INC., CAMBRIDGE, MASS.
Advanced information processing system: Input/output network management software
[NASA-CR-181678] N88-29431
DREXEL UNIV., PHILADELPHIA, PA.
A comprehensive study on damage tolerance properties of notched composite laminates
[AD-A192952] N88-28968
A fundamental study of P/M processed elevated temperature aluminum alloys
[AD-A192958] N88-29005
DUKE UNIV., DURHAM, N. C.
Asymptotic modal analysis and statistical energy analysis
[NASA-CR-183077] N88-29514
DURHAM UNIV. (ENGLAND).
Molecular hydrogen in galaxies N88-29645
Very high energy cosmic gamma rays from radio and X-ray pulsars N88-29711

E

EAGLE ENGINEERING, INC., HOUSTON, TEX.
Space transportation nodes assumptions and requirements: Lunar base systems study task 2.1
[NASA-CR-172052] N88-28944
EDGERTON, GERMESHAUSEN AND GRIER, INC., IDAHO FALLS, IDAHO.
Artificial intelligence applied to process signal analysis N88-29359
EDINBURGH UNIV. (SCOTLAND).
A numerical study of turbulent plane jets in still and flowing environments employing two-equation k-epsilon model N88-29109
ELECTRO MAGNETIC APPLICATIONS, INC., DENVER, COLO.
Investigations into the triggered lightning response of the F106B thunderstorm research aircraft
[NASA-CR-3902] N88-29258
ERNO RAUMFAHRTTECHNIK G.M.B.H., BREMEN (WEST GERMANY).
Solar dynamic power systems
[ETN-88-92969] N88-29224
ESSEX UNIV., COLCHESTER (ENGLAND).
A model of information growth N88-29440
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, GENEVA (SWITZERLAND).
Pseudospark switches
[DE88-702227] N88-29085
EUROPEAN SPACE AGENCY, PARIS (FRANCE).
Additional investigations into the aircraft landing process: Test distributions
[ESA-TT-1099] N88-28913
Modeling of pulsed gas flow lasers
[ESA-TT-1090] N88-29169
Investigations on the entropy of cloudy air
[ESA-TT-1060] N88-29245
On experiences with two hot-wire instruments for measuring the liquid water content in clouds
[ESA-TT-1085] N88-29255
Focus 86: A summary of the 1986 annual report of the activities of the European Space Agency
[ESA-BR-34] N88-29713
EUROPEAN SPACE AGENCY. EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, ESTEC, NOORDWIJK (NETHERLANDS).
Material and process selection and quality control for ESA space systems and associated equipment
[ESA-PSS-01-70-ISSUE-3] N88-29190
EXLOG/BROWN AND RUTH LABS., INC., ENGLEWOOD, COLO.
Nonseismic, surface geophysical and geochemical prospecting technology
[PB88-196813] N88-29207

F

FLORIDA STATE UNIV., TALLAHASSEE.
Unsteady flow past an NACA 0012 airfoil at high angles of attack
[AD-A194650] N88-28888
FORSCHUNGSINSTITUT FUER HOCHFREQUENZPHYSIK, WERTHHOVEN (WEST GERMANY).
Investigations on multiport antennas for polarimetric and modal field scanning
[REPT-5-87] N88-29073
Experimental investigations for the generation of phase modes for adaptive antennas
[REPT-10-87] N88-29074
Development of a multiport-hybrid-mode exciter for use in antennas for polarimetric field measurements
[REPT-12-87] N88-29075
FORSCHUNGSINSTITUT FUER INFORMATIONSVERARBEITUNG, ETTLINGEN (WEST GERMANY).
Automatic line network extraction from aerial imagery of urban areas through knowledge-based image analysis
[AD-A192399] N88-29208
FRAUNHOFER INST. FUER WERKSTOFFMECHANIK, FREIBURG (WEST GERMANY).
Wave and fracture phenomena in impacted ceramics
[AD-A192946] N88-29020

G

GARRETT CORP., TEMPE, ARIZ.
SRB/SLEEC (Solid Rocket Booster/Shingle Lap Extendible Exit Cone) feasibility study, volume 2. Appendix A: Design study for a SLEEC actuation system
[NASA-CR-178974] N88-28965
GELTECH, INC., ALACHUA, FLA.
Development of high efficiency q-switched glass laser via sol-gel processing
[AD-A192301] N88-29154
GENERAL ACCOUNTING OFFICE, WASHINGTON, D. C.
Competition: Issued on establishing and using Federally funded research and development centers
[PB88-178884] N88-29632
GENERAL DYNAMICS CORP., FORT WORTH, TEX.
Generation of multiple block grids for arbitrary 3D geometries N88-29317
GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.
Knowledge-based fault diagnosis on future space vehicles N88-29374
Archetyping: A software generation and management methodology N88-29382
An expert systems application to space base data processing N88-29384
GENERAL ELECTRIC CO., CINCINNATI, OHIO.
E3 10C compressor test analysis of high-speed post-stall data
[NASA-CR-179521] N88-28929
GENERAL RESEARCH CORP., HUNTSVILLE, ALA.
On recognizing ignorance N88-29372
GEOLOGICAL SURVEY, FLAGSTAFF, ARIZ.
Small Martian valcanoes N88-29668
How dirty is Mars' North Polar cap, and why isn't it black N88-29677
Surface units on Mars: The assemblage in the Valles Marineris N88-29680
Morphologic contrasts between Nirgal and Auqakuh Valles, Mars: Evidence of different crustal properties N88-29681
Geology of six possible Martian landing sites N88-29682
Documenting volcano-tectonic episodes in Mars' stratigraphic record N88-29695
GEOLOGICAL SURVEY, MENLO PARK, CALIF.
Viking Landers and remote sensing N88-29685
Ridged and gullied terrains in the Martian uplands N88-29700
GEORGE WASHINGTON UNIV., HAMPTON, VA.
Two biased estimation techniques in linear regression: Application to aircraft
[NASA-TM-100649] N88-29489
GEORGIA INST. OF TECH., ATLANTA.
Ultrafine microstructure composites prepared by chemical vapor deposition
[AD-A193849] N88-28973
Steady and unsteady internal flow computations via the solution of the compressible Navier Stokes equations for low Mach numbers N88-29100
Nonlinear dynamic analysis and optimal control of shallow shells N88-29191
Concepts for robot motion primitives required for space station teleoperations N88-29387
Reasoning about fault diagnosis for the space station common module thermal control system N88-29395
Identification and control of time-varying flexible structures: An artificial intelligence approach N88-29437
Approximations and implementations of nonlinear filtering schemes
[AD-A194685] N88-29482
The acoustic field scattered from some approximate pressure release materials
[AD-A194768] N88-29515
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-182443] N88-29653
GEORGIA-PACIFIC CORP., TOLEDO, OREG.
Reduction in mill air compressor power requirements through installation of a variable frequency speed control
[DE88-008493] N88-29171
GOLD HILL COMPUTERS, INC., CAMBRIDGE, MASS.
The concurrent common Lisp development environment N88-29422
Networking and AI systems: Requirements and benefits N88-29425
GOSUDARSTVENNYI KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, MOSCOW (USSR).
Neutrino electrodynamics and possible effects for solar neutrinos
[DE88-701647] N88-29705
Difficulties with interpretation of underground muons from Cygnus X-3
[DE88-701645] N88-29710
GRONINGEN RIJKSUNIVERSITEIT (NETHERLANDS).
Unfoldings of quasi-periodic tori
[B8811118] N88-29513

H

HAMILTON STANDARD, WINDSOR LOCKS, CONN.
Experimental and analytical evaluation of the effects of simulated engine inlets on the blade vibratory stresses of the SR-3 model prop-fan
[NASA-CR-174959] N88-28927
SR-7A aeroelastic model design report
[NASA-CR-174791] N88-28928
HAMPTON INST., VA.
On Wiener-Masani's algorithm for finding the generating function of multivariate stochastic processes
[NASA-CR-182905] N88-29481
HARRY DIAMOND LABS., ADELPHI, MD.
Waveform analysis on the IBM PC
[AD-A194249] N88-29330
Effects on the resonant frequencies caused by loading a spherical cavity with a dielectric sphere
[AD-A193864] N88-29511
Absorption spectra and energy levels of Gd(3+), Nd(3+) and Cr(3+) in the garnet Gd3Sc2Ga3O12
[AD-A193634] N88-29599
HARVARD UNIV., CAMBRIDGE, MASS.
Correlations between wettability and structure in monolayers of alkanethiols adsorbed on gold
[AD-A194348] N88-28991
HATFIELD POLYTECHNIC (ENGLAND).
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[AD-A193940] N88-29435
HAWAII UNIV., HONOLULU.
Mars: Near-infrared comparative spectroscopy during the 1986 opposition N88-29658
Mars: Spectral signatures seen and unseen N88-29659
Volcano evolution on Mars N88-29686
Episodic vs. epochal release of SO2 on Mars N88-29688
Martian surface analogs: Laboratory spectral studies in the mid infrared N88-29699
Coadsorption of H2O and CO2 on the Martian surface N88-29702
HEIDELBERG UNIV. (WEST GERMANY).
Modeling of a cometary dust coma
[ETN-88-92980] N88-29651
HELSINKI UNIV. TECHNOLOGY, OTANIEMI (FINLAND).
Model test of air-exchange efficiency
[DE88-752862] N88-29049
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Miniature respiratory sensor
[AD-A193430] N88-29300
HIROSHIMA UNIV., TAKEHARA (JAPAN).
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[DE88-753434] N88-29642
HONEYWELL SYSTEMS AND RESEARCH CENTER, MINNEAPOLIS, MINN.
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[AD-A194250] N88-29441
HOUSTON UNIV., TEX.
Some probable characteristics of the Martian regolith N88-29678
Variation in the thickness of ejecta cover on Mars with increasing crater density N88-29701
HUGHES AIRCRAFT CO., TORRANCE, CALIF.
Metal grid base heterojunction transistor operating at 60 and 94 GHz
[AD-A194763] N88-29087

HUMAN RESOURCES RESEARCH ORGANIZATION, ALEXANDRIA, VA.
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29267

I

ILLINOIS UNIV., CHICAGO.
Polyazidoesters as energetic polymers and copolymer components with fluoro derivatives
[AD-A194236] N88-29039
On broadband matching of multiport electrical networks with applications
[AD-A194224] N88-29086
ILLINOIS UNIV., URBANA.
Analysis of the hopfield neural networks and their application to pattern recognition
[AD-A193827] N88-29279
Process migration in UNIX environments
[NASA-CR-182951] N88-29311
A nonparametric multidimensional IRT approach with applications to ability estimation and test bias
[AD-A194212] N88-29483
Active explanation reduction: An approach to the multiple explanations problem
[AD-A194127] N88-29501
INDIANA UNIV., BLOOMINGTON.
Theoretical particle physics
[DE88-011499] N88-29621
INFERENCE CORP., LOS ANGELES, CALIF.
Automated software development workstation N88-29423
INFORMATION SYSTEMS AND TECHNOLOGY CENTER, WRIGHT-PATTERSON AFB, OHIO.
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INNOVATIVE SYSTEMS, RAMEY (PUERTO RICO).
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[AD-A194100] N88-29649
INNSBRUCK UNIV. (AUSTRIA).
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[AD-A194101] N88-29601
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[AD-A194358] N88-29161
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Strategic defense initiative architecture dataflow modeling technique version 1.5
[AD-A194356] N88-29494
SDI (Strategic Defense Initiative) battle management/C3 (Command, Control and Communications) algorithms technology program plan
[AD-A194357] N88-29495
INTEGRATED SUPPORT SYSTEMS, INC., CLEMSON, S.C.
Reliability and Maintainability (R and M)
[AD-A193857] N88-29187
INTEGRATED SYSTEMS, INC., SANTA CLARA, CALIF.
Computer-Aided-Control Engineering (CACE) primitives for robust and adaptive control systems, phase 1
[AD-A192446] N88-29439
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE (ITALY).
Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni3Al
[DE88-702718] N88-29014
Soliton and polaron dynamics in conducting polymers
[DE88-702539] N88-29035
Distortions in processed signals and their application in electronic design. Part 1: Basic and general formulations
[DE88-702731] N88-29070
Distortions in processed signals and their application in electronic design. Part 2: A new variable signal generator
[DE88-702732] N88-29071
Distortions in processed signals and their application in electronic design. Part 3: An automated generator of communication jamming signals
[DE88-702733] N88-29072
Nonequilibrium flow of a radiating gas in a vertical channel with axial temperature variation
[DE88-702535] N88-29120
Evidence for laser emission from the TICT exciplex of coumarin dyes
[DE88-702544] N88-29167
Breakdown of molecular oxygen by brief pulses of laser radiation
[DE88-702687] N88-29168
Theoretical investigation on heterojunction solar cell
[DE88-701837] N88-29219
Global solar radiation in Sierra Leone (West Africa)
[DE88-702725] N88-29252
Mathematical correlation between variations in solar radiation parameters. Part 1: Daily sums of global radiation and midday global radiation
[DE88-702742] N88-29253
Basic causes of amplitude modulation in climatic/weather parameters
[DE88-702743] N88-29254
Critical values of functionals on Banach surfaces
[DE88-702735] N88-29472
Sequential approach to Colombeau's theory of generalized functions
[DE88-701869] N88-29503
Cosmology in an N-dimensional vector space
[DE88-702550] N88-29507
On nonlinear equations admitting soliton solutions with a deBroglie phase
[DE88-702694] N88-29508
Green's function approach to roughening transition of one-dimensional restricted solid on solid model
[DE88-702723] N88-29512
Electron impact ionization cross-section of some organic compounds
[DE88-702044] N88-29525
On selection rules and inelastic electron scattering at intermediate energies
[DE88-701833] N88-29526
Local environment approach for deep-level defects in semiconductors: Application to the vacancy in silicon
[DE88-702017] N88-29573
Properties of strong coupled superconductors
[DE88-702050] N88-29574
Possible mechanism for high-temperature superconductivity in the BaSr-La(Y)-CuO systems
[DE88-702080] N88-29576
Fluctuations of order parameters in the high T(sub c) superconductors
[DE88-702549] N88-29603
Theoretical investigation of image states of the hydrogen covered Cu (100)
[DE88-702662] N88-29604
Anomalous dependence of the thermoelectric power on the temperature in YBaCuO high-T(sub c) superconducting samples
[DE88-702682] N88-29605
System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice
[DE88-702686] N88-29606
Localized excitations in one-dimensional molecular crystal with structural defect
[DE88-702691] N88-29607
New method for preparation of (Cd, Hg)Te thin films
[DE88-702727] N88-29608
Influence of the temperature-dependence of recombination life-time of free carriers in amorphous semiconductors on thermostimulated photocurrent spectra
[DE88-702728] N88-29609
Vibration spectra induced by impurities in 3-5-compounds semiconductors
[DE88-702730] N88-29610
Dependence of high critical temperature of ceramic superconductors on the nominal Cu(sup 3+)Cu(sup 2+) ratio
[DE88-702734] N88-29611
Thermostimulated conductivity in amorphous semiconductors with non-exponential density of localized states
[DE88-702737] N88-29612
Passage of relativistic magnetic dipole moments through magnetic fields
[DE88-702640] N88-29624
Can we calculate the fundamental dimensionless constants of physics
[DE88-702641] N88-29625
Relativistic theory of the Lamb shift based on self energy
[DE88-702658] N88-29626
Holomorphic geometry of interacting string
[DE88-702714] N88-29627
Gravitational redshift of self-gravitating systems of dark matter in the universe
[DE88-702688] N88-29650
ISRAEL ATOMIC ENERGY COMMISSION, YAVNEH.
Spallation and dynamic fracture as an effect of laser induced shock-waves
[AD-A193513] N88-29971
ISRAEL INST. OF METALS, HAIFA.
Laser and electrochemical studies of metallizations in electronic devices
[AD-A193786] N88-29090

J

JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.
Optical emission behavior and radiation resistance of epoxy resins
[DE88-752829] N88-29023
Stability experimental results of cable-in-conduit superconductor for fusion
[DE88-753424] N88-29589
JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.
Recursive mass matrix factorization and inversion: An operator approach to open- and closed-chain multibody dynamics
[NASA-CR-182516] N88-29328
A review: Quantitative models for lava flows on Mars N88-29656
Origin of northern lowland plains: Constraints from boundary morphology N88-29657
Topography of large craters on Mars: Implications for the highlands resurfacing history N88-29691
Mars earth-based radar: 1986 results and 1988-1990 opportunities N88-29697
JOHNS HOPKINS UNIV., BALTIMORE, MD.
Linearized model matching for single-input nonlinear systems
[AD-A193642] N88-29445
JOINT INST. FOR NUCLEAR RESEARCH, DUBNA (USSR).
Open bosonic string in background electromagnetic field
[DE88-702140] N88-29053
Acoustic-optical detector of gravitational waves based on high-quality crystals
[DE88-702459] N88-29232
Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei
[DE88-701500] N88-29570
Towards a finite quantum gravity
[DE88-701497] N88-29619
On the meaning of perturbation expansions in quantum field theory
[DE88-702138] N88-29620

K

KANSAS UNIV. CENTER FOR RESEARCH, INC., LAWRENCE.
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-4182] N88-29891
KAUPPA-JA TEOLLISUUSMINISTERIO, HELSINKI (FINLAND).
Absorption heat pumps
[DE88-752820] N88-29218
KYOTO UNIV. (JAPAN).
Initial operation and edge plasma studies in ATF (Advanced Toroidal Facility)
[DE88-011400] N88-29582
KYOTO UNIV., UJI (JAPAN).
Density fluctuations in currentless high beta plasmas in Heliotron E
[DE88-752310] N88-29550

L

LANCASTER UNIV. (ENGLAND).
Volcano evolution on Mars N88-29686
LASER POWER OPTICS, SAN DIEGO, CALIF.
MIDIR (Mid-Infrared) laser, phase 1
[AD-A193935] N88-29166
LAWRENCE LIVERMORE NATIONAL LAB., CALIF.
Thermodynamic data bases for multivalent elements: An example for ruthenium
[DE88-004395] N88-29084
Regional intercomparisons of General Circulation Model predictions and historical climate data: CO2
[DE88-010416] N88-29248
A survey of the current experimental database for lower hybrid current-drive and heating
[DE88-009830] N88-29552

Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
Non-linear scale invariance in a cold-dark-matter universe
[DE88-011725] N88-29644

LEIDEN UNIV. (NETHERLANDS).
An experimental setup for the study of polarized He3 and dilute He3-He4 mixtures
[B8705589] N88-29001
Stability and convergence in the numerical solution of stiff initial value problems
[B8681480] N88-29474
Nonlinear elliptic problems with critical exponent in shrinking annuli
[W-87-02] N88-29477
Elliptic equations with nearly critical growth
[W-87-16] N88-29478
Invariant ideals of multiplicity free algebraic group actions
[B8603517] N88-29509
Nuclear magnetic ordering and paramagnetic relaxation of diatomic molecules in Ca (OH)2
[B8681469] N88-29532
Static and dynamic behavior of a quasi one-dimensional Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a He3-He4 dilution refrigerator
[B8705564] N88-29533
Fluctuation and relaxation phenomena studied by means of nuclear orientation
[B8679671] N88-29534
The thermal conductivity of dirty type 2 superconductors
[B8681488] N88-29615

LISP MACHINES, INC., LOS ANGELES, CALIF.
Real-time space system control with expert systems N88-29419

LOCKHEED MISSILES AND SPACE CO., HUNTSVILLE, ALA.
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[NASA-CR-181636] N88-29115

LOCKHEED MISSILES AND SPACE CO., SUNNYVALE, CALIF.
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LONDON UNIV. OBSERVATORY (ENGLAND).
Lava flow-field morphology: A case study from Mount Etna, Sicily N88-29676

LOS ALAMOS NATIONAL LAB., N. MEX.
Proof-of-principle high speed electronic imaging system, phase 2
[AD-A193798] N88-28937
Defensive platform size and survivability
[DE88-011634] N88-28948
Raman spectroscopy on simple molecular systems at very high density
[DE88-010947] N88-28987
Recent advances in high-power microwave amplifiers
[DE88-007820] N88-29083
Influence of peak pressure on the substructure evolution and shock wave profiles of Ti-6Al-4V
[DE88-006458] N88-29197
Mathematical theory and calculations of magnetic hysteresis curves
[DE88-011055] N88-29510
Moment invariants for particle beams
[DE88-011052] N88-29537
Fusion product spectra
[DE88-010912] N88-29554
Introduction to laser plasma diagnostics
[DE88-011056] N88-29560
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
Electron microscopy of ceramic superconductors
[DE88-006446] N88-29580
New developments in capital cost estimating
[DE88-005392] N88-29638

LOUGHBOROUGH UNIV. OF TECHNOLOGY (ENGLAND).
Generating semi-Gaussian two dimensional quadrature rules
[REPT-205] N88-29476
On matrix pencil equivalents of a general polynomial matrix
[MATH-REPT-207] N88-29479
The calculation of time dependent eddy currents in tokamaks
[REPT-206] N88-29568
On neutrino fields in Einstein-Cartan theory
[MATH-REPT-208] N88-29629
On the degenerate Ferrari-Ibanez solution for colliding plane gravitational waves
[MATH-REPT-209] N88-29630

LOWELL UNIV., MASS.
Ionospheric convection and structure using ground-based digital ionosondes
[AD-A194246] N88-29237

LUNAR AND PLANETARY INST., HOUSTON, TEX.
MEVTV Workshop on Nature and Composition of Surface Units on Mars
[NASA-CR-183075] N88-29654
The history of Martian volcanism determined from a revised relative chronology N88-29657
Sub-kilometer rampart craters in the equatorial region of Mars: Possible implications for the state and distribution of regolith H2O N88-29666
Variability in spectral signatures of terrestrial volcanic rocks and implications for volcanology on Mars N88-29672
High resolution Viking Orbiter images: A useful data source for testing the viability of geomorphic processes attributed to Martian landforms N88-29703

M

MACDONALD, DETTWILER AND ASSOCIATES LTD., RICHMOND (BRITISH COLUMBIA).
Central user and browse service
[CU-PG-MDA-SY-0005] N88-29637

MANAGEMENT CONSULTING AND RESEARCH, INC., FALLS CHURCH, VA.
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[AD-A194605] N88-28923

MANCHESTER UNIV. (ENGLAND).
Dynamics of interacting galaxies N88-29647

MARINE IMAGING SYSTEMS, INC., POCASSET, MASS.
Remotely Operated Vehicle (ROV) reliability study, phase 1
[AD-A194367] N88-29177

MARTIN MARIETTA AEROSPACE, DENVER, COLO.
ARGES: An expert system for fault diagnosis within space-based ECLS systems N88-29380
A scheduling and resource management system for space applications N88-29383
Intelligent resource management for local area networks: Approach and evolution N88-29385
Knowledge acquisition and rapid protyping of an expert system: Dealing with real world problems N88-29394
Intelligent interface design and evaluation N88-29405
Blackboard architectures and their relationship to autonomous space systems N88-29414
Design consideration in constructing high performance embedded Knowledge-Based Systems (KBS) N88-29415
Next-generation space manipulator N88-29428
Elemental composition of the Martian surface N88-29665

MARYLAND UNIV., COLLEGE PARK.
Fellowships in hypersonic aerodynamics
[AD-A194265] N88-28885
Nuclear and ionic charge distribution experiment on ISEE-1 and ISEE-3
[NASA-CR-180776] N88-28947
Free electron lasers with small period wigglers
[DE88-011627] N88-29158

MASCHINENFABRIK AUGSBURG-NUERNBERG A.G., MUNICH (WEST GERMANY).
Solar dynamic power systems
[ETN-88-92969] N88-29224

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Infrared detection using Rydberg atoms
[AD-A194308] N88-28990
Sinterable ceramic powders from laser-heated gases
[AD-A194162] N88-29024
Blends of crystallizable polybutadienes
[AD-A194536] N88-29026
Improvements in techniques of microwave thermography
[AD-A194613] N88-29062
Approximate evaluation of semi-Markov chain reliability models
[AD-A194669] N88-29185
Improvements in techniques of microwave thermography
[AD-A193620] N88-29276
A proof of the Kahn principle for input/output automata
[AD-A194454] N88-29333
Weathering of sulfides on Mars N88-29662
Chemical interactions between the present-day Martian atmosphere and surface minerals N88-29689

MASSACHUSETTS INST. OF TECH., LEXINGTON.
Airport surface traffic automation study
[AD-A194553] N88-28934
Large aperture multi-dimensional laser radar testbed
[AD-A193447] N88-29155

MASSACHUSETTS UNIV., AMHERST.
The radiation sensitivity of select metal chelate polymers: Mechanistic changes at higher energies
[AD-A193467] N88-29019
Constraints on the origin of fractured terrane, Northern Martian plains N88-29684

MATRA ESPACE, TOULOUSE (FRANCE).
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book A: Autonomy concept description
[ESA-CR(P)-2555-VOL-1] N88-28955
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book B: Autonomy concept application example
[ESA-CR(P)-2555-VOL-2] N88-28956
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[ESA-CR(P)-2555-VOL-3] N88-28957

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[AD-A194191] N88-28883
The influence of delay effects on the decay of liquid jets
[MPIS-14/1987] N88-29130
Construction of a laser Doppler anemometer and its use for the testing of a novel probe for the measurement of the variations of the lateral component of the vortex vector
[MPIS-13/1987] N88-29147
Two phase flow in a rotating screw tube (screw tube pump). Investigation of the function and efficiency of the screw tube pump
[MPIS-16/1987] N88-29178

MCDONNELL-DOUGLAS RESEARCH LABS., ST. LOUIS, MO.
Three-dimensional vortex interactions
[AD-A194066] N88-28889

MECHANICAL TECHNOLOGY, INC., LATHAM, N. Y.
Development of high temperature, high pressure rotating shaft seals
[DE88-001029] N88-29172

MERCURY LPE CO., INC., PITTSBURGH, PA.
Lattice-matched HgZnTe epitaxy development
[AD-A193677] N88-29600

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., BREMEN (WEST GERMANY).
Delta wing configurations N88-28860
Variable wing camber control systems for the future Airbus program
[MBB-UT-104/88] N88-28932

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[ESA-CR(P)-2555-VOL-2] N88-28956
Study of standard generic approach for spacecraft (S/C) autonomy and automation (phase 3). Book C: Autonomy concept summary
[ESA-CR(P)-2555-VOL-3] N88-28957
Orbital Propulsion Module (OPM). Study on coni-spherical surface tension tanks (COSTA)
[MBB-URV-170/87] N88-28963

MESSERSCHMITT-BOELKOW G.M.B.H., MUNICH (WEST GERMANY).
Grid generation for an advanced fighter aircraft N88-29319

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[AD-A194264] N88-29025

MICHIGAN STATE UNIV., EAST LANSING.
Estimation of transient heat transfer coefficients in multidimensional problems by using inverse heat transfer methods N88-29108
Large-grain pipelining on distributed-memory multiprocessors
[DE88-009974] N88-29432

MICHIGAN UNIV., ANN ARBOR.
Coding for meteor-burst communications channel and side information for channels with block-interference N88-29054

A singular perturbation analysis of the weakly nonlinear evolution of long and short water waves and waves in boundary layers N88-29102
Thickness effects on the stability of shell like structures N88-29192
Studies on strained (In,Ga)As/GaAs semiconductors and optical devices N88-29575
An upper limit on the primordial He4 abundance from speckle interferometric observations of muon Cassiopeiae N88-29641

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY).
Environmental effects on transition and boundary layer characteristics N88-28876

MIDWEST RESEARCH INST., GOLDEN, COLO.
Dynamic response of a 330-kW horizontal axis wind turbine generator
[DE88-001136] N88-29212
SERI's photovoltaic research project: A foundation for tomorrow's utility-scale electricity
[DE88-001161] N88-29220

MINNESOTA MINING AND MFG. CO., ST. PAUL.
Blue-green laser diode research program
[AD-A191980] N88-29153

MINNESOTA UNIV., MINNEAPOLIS.
Piecewise-parabolic methods for systems of hyperbolic conservation laws in multiprocessing environments
[DE88-010202] N88-29329

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Plasmoid propagation
[AD-A192378] N88-29555

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.
Composite grid generation for aircraft configurations with the EAGLE code N88-29321

MISSOURI UNIV., COLUMBIA.
Intrinsic and extrinsic energy states of semiconductors and heterostructures using novel techniques
[DE88-008560] N88-29582

MITRE CORP., HOUSTON, TEX.
A methodology for multiple rule system integration and resolution within a singular knowledge base N88-29413

MITRE CORP., MCLEAN, VA.
Neutrino detection primer
[AD-A193805] N88-29529

MONSANTO RESEARCH CORP., MIAMISBURG, OHIO.
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29046

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NAGOYA UNIV. (JAPAN).
Prompt simultaneous acceleration of protons and electrons to relativistic energies by shock waves in solar flares
[DE88-752553] N88-29706

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Techniques for boundary layer tripping and control N88-28863

NATIONAL AERONAUTICAL ESTABLISHMENT, OTTAWA (ONTARIO).
An overview of technology for spoken interaction with machines
[AD-A194153] N88-29058

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.
Contributions to the modeling of wind shear for danger studies
[NASA-TT-20293] N88-28900
Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum hydroxide
[NASA-TT-20332] N88-29003
Reaction-theoretical aspects of the thermal behavior of lubricating oils and working fluids
[NASA-TT-20304] N88-29041
The diamond as a new electronic material
[NASA-TT-20354] N88-29098
Shock waves in unsteady flows
[NASA-TT-20329] N88-29134
Study of experimental technique of oil flow with emphasis on quantitative determination of the flow position parameters on the surface
[NASA-TT-20341] N88-29135
Surface properties in electric discharge machining
[NASA-TT-20243] N88-29182
Study on design and control of torque-controlled manipulators
[NASA-TT-20197] N88-29183
Present state of knowledge of the upper atmosphere 1988: An assessment report
[NASA-RP-1208] N88-29233
Space station as a vital focus for advancing the technologies of automation and robotics
[IAF-88-62] N88-29352
Diamond film by hot filament CVD method
[NASA-TT-20335] N88-29618
The construction of the thermoelasticity equations on the basis of contemporary notions of nonlinear continua mechanics
[NASA-TT-20307] N88-29631

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.
High performance forward swept wing aircraft
[NASA-CASE-ARC-11636-1] N88-28914
Test results at transonic speeds on a contoured over-the-wing propfan model
[NASA-TM-88206] N88-28918
Boron-containing organosilane polymers and ceramic materials thereof
[NASA-CASE-ARC-11649-1-SB] N88-29040
Three-dimensional elliptic grid generation for an F-16 N88-29315
Knowledge elicitation for an operator assistant system in process control tasks N88-29366
Stability of semidiscrete approximations for hyperbolic initial-boundary-value problems: Stationary modes
[NASA-TM-100994] N88-29455
Chemical and spectroscopic characterization of a suite of Mars soil analogs N88-29667
Preliminary analysis of recent 2.2-4.2 micrometers telescopic observations of Elysium, Mars: Implications for crystallinity and hydration state of surface materials N88-29692

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
Surface Tension Confined Liquid Cryogen Cooler (STCLCC)
[NASA-CASE-GSC-13112-1] N88-29050
Polymeric heat pipe wick
[NASA-CASE-GSC-13019-1] N88-29133
Catalog of open clusters and associated interstellar matter
[NASA-RP-1202] N88-29652
Gamma-ray/neutron spectroscopy from the Mars observer N88-29671

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEX.
Expandable pallet for space station interface attachments
[NASA-CASE-MSC-21117-1] N88-28958
Method of forming dynamic membrane on stainless steel support
[NASA-CASE-MSC-18172-3] N88-29052
High effectiveness contour matching contact heat exchanger
[NASA-CASE-MSC-20840-1] N88-29132
Collet lock joint for space station truss
[NASA-CASE-MSC-21207-1] N88-29180
Preloaded brake disc
[NASA-CASE-MSC-21132-1] N88-29181
A software engineering approach to expert system design and verification N88-29358
Intelligent interfaces for expert systems N88-29397
Requirements for a tool to aid in the development of expert systems for space station applications N88-29398
Benchmarking expert system tools N88-29399
Two implementations of the Expert System for the Flight Analysis System (ESFAS) project N88-29400
Aqueous alteration in S-N-C meteorites and implications for weathering products on Mars N88-29673

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.
High-aspect-ratio wings N88-28859
Effects of independent variation of Mach and Reynolds numbers on the low-speed aerodynamic characteristics of the NACA 0012 airfoil section
[NASA-TM-4074] N88-28879
Accurate solutions, parameter studies and comparisons for the Euler and potential flow equations
[NASA-TM-100664] N88-28892
Steady and unsteady transonic pressure measurements on a clipped delta wing for pitching and control-surface oscillations
[NASA-TP-2594] N88-28895
Finite Element Composite Analysis Program (FECAP) for a microcomputer
[NASA-TM-100670] N88-28982
Method and device for determining heats of combustion of gaseous hydrocarbons
[NASA-CASE-LAR-13528-1] N88-29002
Method and apparatus for non-destructive testing of temper embrittlement in steels
[NASA-CASE-LAR-13817-1] N88-29012
Method of dispensing reagent chemicals in space
[NASA-CASE-LAR-13607-1-CU] N88-29048
Method for maintaining precise suction strip porosities
[NASA-CASE-LAR-13638-1] N88-29051
Skin friction balance
[NASA-CASE-LAR-13710-1] N88-29145
Ice detector
[NASA-CASE-LAR-13776-1] N88-29149
Liquid thickness gauge
[NASA-CASE-LAR-13826-1] N88-29150
Forty-eight-inch lidar aerosol measurements taken at the Langley Research Center, May 1974 to December 1987
[NASA-RP-1209] N88-29234
The 1983 direct strike lightning data, part 1
[NASA-TM-86426-PT-1] N88-29259
The 1983 direct strike lightning data, part 2
[NASA-TM-86426-PT-2] N88-29260
The 1983 direct strike lightning data, part 3
[NASA-TM-86426-PT-3] N88-29261
Grid generation on and about a cranked-wing fighter aircraft configuration N88-29318

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.
Arcjet power supply and start circuit
[NASA-CASE-LEW-14374-1] N88-28939
Lewis Research Center space station electric power system test facilities
[NASA-TM-100924] N88-28942
Assessment of the effects of space debris and meteoroids environment on the space station solar array assembly
[NASA-TM-101315] N88-28959
Thin film coatings for space electrical power system applications
[NASA-TM-101325] N88-28966
Investigation of a SiC/Ti-24Al-11Nb composite
[NASA-TM-100956] N88-28980
Optical measurement of unducted fan blade deflections
[NASA-TM-100966] N88-29142
Application of optical correlation techniques to particle imaging velocimetry
[NASA-TM-101306] N88-29152
Improved finite strip Mindlin plate bending element using assumed shear strain distributions
[NASA-TM-100928] N88-29195

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.
High temperature electric arc furnace
[NASA-CASE-MFS-28281-1] N88-28938
Wind measurements by electromagnetic probes
[NASA-TM-4066] N88-29256
Second Conference on Artificial Intelligence for Space Applications
[NASA-CP-3007] N88-29351
Coupling expert systems and simulation N88-29360
Machine vision for real time orbital operations N88-29367
Expert systems for MSFC power systems N88-29375
The use of computer graphic simulation in the development of robotic systems N88-29388
Experiment scheduling for Spacelab missions N88-29404
The emergence of multi-user expert systems N88-29406
An expert system for a distributed real-time trainer N88-29411
Validation of expert systems N88-29416
Planar thin film SQUID with integral flux concentrator
[NASA-CASE-MFS-28282-1] N88-29602

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CALIF.
Method for Veterbi decoding of large constraint length convolutional codes
[NASA-CASE-NPO-17310-1-CU] N88-28948
Digital phase-lock loop having an estimator and predictor of error
[NASA-CASE-NPO-17196-1-CU] N88-29076
Power supply conditioning circuit
[NASA-CASE-NPO-17233-1-CU] N88-29095
Thermocouple for heating and cooling of memory metal actuators
[NASA-CASE-NPO-17068-1-CU] N88-29151
Nanosequencer digital logic controller
[NASA-CASE-NPO-16116-2] N88-29310

NATIONAL AEROSPACE LAB., AMSTERDAM (NETHERLANDS).
Reynolds number effects and the wind tunnel environment N88-28862
Empirical tools for simulation methodologies N88-28866

NATIONAL AEROSPACE MEDICAL CENTRE, SOESTERBERG (NETHERLANDS).
Activities report in aerospace medicine
[ETN-88-92906] N88-29283

NATIONAL BUREAU OF STANDARDS, GAITHERSBURG, MD.
Stress corrosion of ceramic materials
[AD-A191979] N88-29016
The NBS/NRL (National Bureau of Standards/Naval Research Laboratory) free electron laser facility
[AD-A194214] N88-29159
Analysis of free electron laser performance utilizing the National Bureau of Standards CW microtron
[AD-A194217] N88-29160
NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).
A study of the National Physics Laboratory microdosimetry research programme in collaboration with the University of Leeds (United Kingdom)
[NPL-RS(EXT)-93] N88-29148
Noise levels from a jet-engined aircraft measured at ground level and at 1.2 m above the ground
[NPL-AC-114] N88-29524
NATIONAL RADIOLOGICAL PROTECTION BOARD, HARWELL (ENGLAND).
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).
Computational tools for simulation methodologies
N88-28865
NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PA.
Cleanability of aircraft polyurethane topcoats
[AD-A193456] N88-28878
AGARD (Advisory Group for Aerospace Research and Development) engine disc material cooperative test (supplementary program)
[AD-A193678] N88-28925
NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CALIF.
Effect of phase errors in stepped-frequency radar systems
[AD-A194478] N88-29061
Reflection and scattering of acoustic rays computed for parabolic ice keel models
[AD-A193898] N88-29517
NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIF.
Estimation forces acting on an underwater vehicle with G.P.S. (Global Positioning System) and Kalman filtering
[AD-A194330] N88-28901
Flow visualization on a small scale
[AD-A194728] N88-28935
Hot-wire measurements of compressor blade wakes in a cascade wind tunnel
[AD-A194737] N88-28936
Interactive, networked moving platform simulators
[AD-A192374] N88-28940
Effect of fiber diameter on the reliability of composites - automated laser diffraction implementation
[AD-A193524] N88-28972
Use of a coherent square wave reference to demodulate BPSK (Binary Phase Shift Keying) carriers and a visual indicator of the quality of received QPSK (Quadrature Phase Shift Keying) carriers
[AD-A193526] N88-29065
The spatial and temporal variability of the arctic atmospheric boundary layer and its effect on electromagnetic (EM) propagation
[AD-A193968] N88-29068
Natural convection immersion cooling of an array of simulated chips in an enclosure filled with dielectric liquid
[AD-A193594] N88-29088
Computer aided filter design
[AD-A193959] N88-29093
Flow visualization by laser sheet
[AD-A194481] N88-29111
A mapping of the viscous flow behavior in a controlled diffusion compressor cascade using laser Doppler velocimetry and preliminary evaluation of codes for the prediction of stall
[AD-A194490] N88-29112
Analysis of the effect of faulty spares on the performance of diagnostic algorithms in reliable systems
[AD-A193526] N88-29166
Experimental investigation of the effects of underwater exposure on the damping characteristics of bolted structural connections for plates and shells
[AD-A194486] N88-29200
Construction of gallium arsenide solar concentrator for space use
[AD-A194658] N88-29222
Atmospheric angular momentum and length of day
[AD-A194505] N88-29238
Interactions between synoptic and planetary scales of motion
[AD-A192328] N88-29246
An objective technique for Arctic cloud analysis using multispectral AVHRR (Advanced Very High Resolution Radiometer) satellite imagery
[AD-A194732] N88-29250
Meteorological features during the marginal ice zone experiment from 20 March to 10 April 1987
[AD-A193980] N88-29251
Feasibility study of a microprocessor controlled actuator test mechanism
[AD-A194854] N88-29337
A computer program package for introductory one-dimensional digital signal processing applications
[AD-A194656] N88-29338
Adaptive identification by systolic arrays
[AD-A193532] N88-29444
Digital filter design techniques
[AD-A194484] N88-29486
An investigation of acoustic cavitation produced by pulsed ultrasound
[AD-A193523] N88-29518
Acoustic pressure distribution on the bottom of a wedge-shaped ocean
[AD-A193961] N88-29518
Diffraction transition radiation from periodic electron bunches
[AD-A193593] N88-29526
Long haul underwater fiber optic link
[AD-A194487] N88-29542
NAVAL RESEARCH LAB., WASHINGTON, D.C.
The gradient method for interface tracking
[AD-A194477] N88-29334
Kinetic theory for electrostatic waves due to transverse velocity shears
[AD-A193404] N88-29557
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
NAVAL SUBMARINE MEDICAL RESEARCH LAB., GROTON, CONN.
Effect of hypoxia on speech recognition in noise
[AD-A193943] N88-29280
NAVAL SURFACE WARFARE CENTER, SILVER SPRING, MD.
Nonlinear analysis of non-neutral plasmas
[AD-A192506] N88-29556
NAVAL UNDERWATER SYSTEMS CENTER, NEW LONDON, CONN.
Systolic array fault tolerance performance analysis
[AD-A193521] N88-29306
Wigner distribution function: Relation to short-term spectral estimation, smoothing and performance in noise
[AD-A193865] N88-29492
NAVAL WAR COLL., NEWPORT, R. I.
SDI (Strategic Defense Initiative): A policy analysis
[AD-A194240] N88-29493
NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER, SAN DIEGO, CALIF.
Reliability and construct validity of reaction time, inspection time and machine-paced tests of cognitive speed
[AD-A193779] N88-29289
NEBRASKA UNIV., LINCOLN.
Electrochemical and optical studies of model photosynthetic systems
[DE88-009291] N88-29264
Canonical forms in the control of DPS
[AD-A194871] N88-29481
NEVADA UNIV., RENO.
Aerodynamics of seeing on large transport aircraft
[NASA-CR-183122] N88-28896
Numerical investigations in three-dimensional internal flows
[NASA-CR-183108] N88-29106
NEW MEXICO STATE UNIV., UNIVERSITY PARK.
Activity-rotation relations for lower main sequence stars N88-29540
NEW MEXICO UNIV., ALBUQUERQUE.
Beam optics test stand
[AD-A193901] N88-29144
NEW YORK UNIV., NEW YORK.
SQUID (superconducting quantum interference device) arrays for simultaneous magnetic measurements: Calibration and source localization performance
[AD-A193815] N88-29143
CryoSQUID: A SQUID-based magnetic field sensor
[AD-A194237] N88-29275
Methods and instrumentation for biomagnetism
[AD-A193811] N88-29278
Visual motion perception and visual attentive processes
[AD-A193640] N88-29288
NORTH CAROLINA STATE COLL., RALEIGH.
Charge storage and switching phenomena in metal complexes
[AD-A193778] N88-29096
NORTH CAROLINA STATE UNIV., RALEIGH.
Band electronic structures and crystal packing forces
[DE88-010247] N88-29585
NORTH CAROLINA UNIV., CHAPEL HILL.
Unification and set-valued functions for functional and logic programming
[AD-A193643] N88-29341
Weak solution of the Langevin equation on a generalized functional space
[AD-A194290] N88-29456
An asymptotic evaluation of the tail of a multiple symmetric alpha-stable integral
[AD-A194570] N88-29460
Practical higher-order functional and logic programming based on lambda-calculus and set-abstraction
[AD-A193845] N88-29466
On stable Markov processes
[AD-A192892] N88-29482
Limiting distributions of non-linear vector functions of stationary Gaussian processes
[AD-A194569] N88-29488
NORTH STAR RESEARCH INST., ALBUQUERQUE, N. MEX.
Plasmoid propagation
[AD-A192378] N88-29555
NORTHWESTERN UNIV., EVANSTON, ILL.
Polymeric electrolytes
[AD-A193768] N88-29031
Stability control of leakage flow channels
[DE88-009995] N88-29107
Theoretical studies in high energy physics
[DE88-011606] N88-29538

O

OAK RIDGE GASEOUS DIFFUSION PLANT, TENN.
Development of the Simplified Compressor Model (SCM) for performance analysis of gaseous diffusion compressors
[DE88-009066] N88-29173
OAK RIDGE NATIONAL LAB., TENN.
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28950
High definition television: Evaluation for remote task performance
[DE88-011573] N88-29057
Regional environmental studies using national data bases and GIS (Geographic Information System)
[DE88-008366] N88-29225
Initial operation and edge plasma studies in ATF (Advanced Toroidal Facility)
[DE88-011400] N88-29562
OBSERVATOIRE DE PARIS-MEUDON (FRANCE).
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES, PARIS (FRANCE).
Study of biological effects and radiation protection to future European manned space flights
[DGT-33061] N88-29535
OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES, TOULOUSE (FRANCE).
Boundary layer development and transition
N88-28871
Knowledge elicitation for an operator assistant system in process control tasks N88-29366
OHIO STATE UNIV., COLUMBUS.
An investigation into the metallurgical aspects of joining rapidly-solidified aluminum alloys
[AD-A194677] N88-29009
Motion planning for legged locomotion systems on uneven terrain N88-29170
Parallel real-time expert systems
[AD-A193673] N88-29434
Distributed knowledge base systems for diagnosis and information retrieval
[AD-A193107] N88-29633
OHIO UNIV., ATHENS.
Electronic states in tunneling semiconductor superlattices
[DE88-011571] N88-29587
OKLAHOMA STATE UNIV., STILLWATER.
Photorefractive damage mechanism in electro-optic materials
[AD-A194560] N88-29543
OLD DOMINION UNIV., NORFOLK, VA.
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-180484] N88-29116
Passive damping concepts for free and forced member and grillage vibration
[NASA-CR-183114] N88-29196

Airborne radar technology for windshear detection
[NASA-CR-183203] N88-29257

OLIS ENGINEERING, SEDALIA, COLO.
Advanced development waste processing unit for combat vehicles, phase 2
[AD-A193793] N88-29302

P

PACIFIC WIND ENERGY, INC., CORVALLIS, OREG.
Effects of precipitation on wind turbine performance
[DE88-001144] N88-29211

PARIS VI UNIV. (FRANCE).
High power storage system based on thin film solid ionics
[AD-A193623] N88-29598

PEKING UNIV. (CHINA).
An introduction to the historical records of China about Mars N88-29664

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Advanced processing and properties of high performance alloys
[AD-A193767] N88-29010
The mechanical behavior of surface modified ceramics
[DE88-010564] N88-29022
Stability and drag reduction in a boundary layer with microbubbles
[AD-A191975] N88-29099
Coupling between radiation and gas dynamics
[AD-A194593] N88-29113
A multiple-scales partial solution of the pulse-forced Rayleigh-Plesset equation of cavitation bubble dynamics
[AD-A193733] N88-29118
Evaluation of atmospheric effects for operational tactical decision aid
[AD-A194205] N88-29236

PENNSYLVANIA UNIV., PHILADELPHIA.
Transformations of short-term visual memory
[AD-A193873] N88-29290
Nonlinear optical processes in molecular systems
[AD-A193871] N88-29546

PERSONNEL DECISIONS RESEARCH INST., MINNEAPOLIS, MINN.
Literature review: Validity and potential usefulness of psychomotor ability tests for personnel selection and classification
[AD-A193558] N88-29287

PHOTOMETRICS, INC., WOBURN, MASS.
Program to increase the measurement capabilities of the AFGL (Air Force Geophysics Laboratory) fixed and mobile high altitude lidar systems
[AD-A194614] N88-29083

PITTSBURGH UNIV., PA.
Vortex dynamics of coherent and chaotic structures (including algorithms for computer simulations and diagnosis)
[AD-A193580] N88-29117
Strong law for mixing sequence
[AD-A193615] N88-29490

POLYTECHNIC INST. OF BROOKLYN, FARMINGDALE, N. Y.
Basic research in electronics (JSEP) Joint Services Electronics Program
[AD-A193072] N88-29079

POLYTECHNIC UNIV., FARMINGDALE, N.Y.
Wide band gyrotron traveling wave amplifier analysis
[AD-A194269] N88-29139

POTTER (J. LEITH), NASHVILLE, TENN.
Missiles, fuselage and similar bodies N88-28858
Missiles, fuselages and similar bodies N88-28869

PRINCETON UNIV., N. J.
A fast parametric maximum flow algorithm, revision
[AD-A194026] N88-29345
A linear-time algorithm for finding a minimum spanning pseudoforest
[AD-A194029] N88-29346
Faster algorithms for the shortest path problem
[AD-A194031] N88-29347
Faster scaling algorithms for network problems
[AD-A194032] N88-29348
Finding minimum-cost circulations by canceling negative cycles
[AD-A194027] N88-29468
Finding minimum-cost circulations by successive approximation
[AD-A194028] N88-29469
Relaxed heaps: An alternative to fibonacci heaps
[AD-A194030] N88-29470
Improved time bounds for the maximum flow problem
[AD-A194034] N88-29471

PROMETHEUS, INC., MIDDLETOWN, R.I.
Polynomials with restricted coefficients and their applications
[AD-A192589] N88-29055

PURDUE UNIV., WEST LAFAYETTE, IND.
Soot and radiation in a gas turbine combustor
[AD-A191991] N88-28924
Super hydrides
[AD-A193710] N88-28995
DARPA-URI consortium meetings on submicron heterostructures of diluted magnetic semiconductors
[AD-A193499] N88-29081
Selecting the best binomial population: Parametric empirical Bayes approach
[AD-A193341] N88-29450
Commentary on Harold Hotelling's articles on the teaching of statistics
[AD-A194215] N88-29484

Q

QUANTEX CORP., ROCKVILLE, MD.
Large area nuclear particle detectors using ET materials
[NASA-CR-180777] N88-29136

R

RAND CORP., SANTA MONICA, CALIF.
Typical weather months in the past (1973-1983) in Central Europe
[AD-A194701] N88-29249

RECOM SOFTWARE, INC., SAN JOSE, CALIF.
AI and simulation: What can they learn from each other N88-29391

REGENSBURG UNIV. (WEST GERMANY).
Temperature dependence of conductivity and of Hall coefficients for noble metal films
[ETN-88-92981] N88-29616

RENSSELAER POLYTECHNIC INST., TROY, N.Y.
Metal halide optical glasses
[AD-A193794] N88-29032
Technical communication in the computer industry: An information-development process to track, measure and ensure quality N88-29635

RHODE ISLAND UNIV., KINGSTON.
Atmospheric deposition of nitrate to the ocean surface N88-29227

RIO GRANDE DO SUL UNIV., PORTO ALEGRE (BRAZIL).
Measure of hydrogen concentration profile in materials by resonant nuclear reactions
[DE88-702599] N88-28999
Rapid thermal annealing of silicon layers amorphized by ion implantation
[DE88-702307] N88-29591

ROBERTS RESEARCH LAB., TORRANCE, CALIF.
Development and verification of NASA Standard Initiator-2 (NSI-2)
[NASA-CR-172069] N88-29044
Development and verification of NASA Standard Initiator-2 (NSI-2): Appendix
[NASA-CR-172070] N88-29045

ROCHESTER UNIV., N. Y.
LLE (Laboratory for Laser Energetics) review
[DE88-008065] N88-29158
Dynamic analysis of computer and communications sytems: Semi-Markov approach N88-29305
Optical emission from surface waves supported in thin metal films N88-29540
Investigation of non-classical effects in two-photon interference processes N88-29541
Center for opto-electronic systems research instrumentation grant
[AD-A193711] N88-29545
Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser
[DE88-011329] N88-29579
Phase sensitive amplification with SIS (Superconductor-Insulator-Superconductor) quasiparticle mixers
[AD-A194594] N88-29596

ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CALIF.
Utilization of artificial intelligence techniques for the Space Station power system N88-29412
Beam combining by phase transition nonlinear media
[AD-A194116] N88-29547

ROCKWELL INTERNATIONAL CORP., THOUSAND OAKS, CALIF.
Research on crystal and film ferroelectric materials for optoelectronic applications
[AD-A193512] N88-29597

ROME AIR DEVELOPMENT CENTER, GRIFFISS AFB, N.Y.
A novel method to correct radiation pattern distortion of conformal antennas
[AD-A193675] N88-29066
Reliability assessment of Surface Mount Technology (SMT)
[AD-A193759] N88-29089

ROYAL AIR FORCE INST. OF AVIATION MEDICINE, FARNBOROUGH (ENGLAND).
Vision and visual protection in fast jet aircraft N88-29292

ROYAL DANISH AIR FORCE, VOJENS.
Visual related accidents/incidents N88-29293

ROYAL INST. OF TECH., STOCKHOLM (SWEDEN).
Snapshots of high-latitude electrodynamics using Viking and DMSP/F7 observations
[TRITA-EPP-88-01] N88-29244

ROYAL NETHERLANDS AIR FORCE, ZEIST.
Maintenance of vision-related components N88-29296

ROYAL SIGNALS AND RADAR ESTABLISHMENT, MALVERN (ENGLAND).
Fine resolution errors in secondary surveillance radar altitude reporting
[RSRE-87019] N88-29906
Tunnelling currents in reverse biased CMT photodiodes
[RSRE-MEMO-4137] N88-29087
The SMITE modular compilation system
[RSRE-MEMO-4145] N88-29307
The SMITE object oriented backing store
[RSRE-MEMO-4147] N88-29308
Formal specification of a secure document control system for SMITE
[RSRE-88002] N88-29309
Hidden Markov models for automatic speech recognition: Theory and application
[RSRE-MEMO-4135] N88-29350
Radial basis functions, multi-variable functional interpolation and adaptive networks
[RSRE-MEMO-4148] N88-29436
A theoretical and experimental investigation into the use of SAW weighting techniques in optical diffraction gratings
[RSRE-MEMO-4128] N88-29549

S

SAN JOSE STATE UNIV., CALIF.
Ridged and gullied terrains in the Martian uplands N88-29700

SANDERS ASSOCIATES, INC., NASHUA, N. H.
Artificial intelligence software acquisition program, volume 1
[AD-A194104] N88-29447

SANDIA NATIONAL LABS., ALBUQUERQUE, N. MEX.
Sol-gel kinetics: Si(sup)29 NMR and a statistical reaction model
[DE88-011545] N88-28988
Initiation of explosive molten aluminum-water interactions at wet or underwater surfaces
[DE88-004686] N88-29006
The design of methane activation catalysts
[DE88-002265] N88-29043
Semiconductor bridge (SCB) igniter studies. 1: Comparison of SCB and hot-wire pyrotechnic actuators
[DE88-008802] N88-29048
Evaluation of silicon-on-insulator MOS (Metal-Oxide-Semiconductor) transistor response to 10-keV X-ray and cobalt-60 irradiation
[DE88-006102] N88-29082
HPM (High-Power Microwave) coupling into realistic targets
[DE88-011788] N88-29084
Static and dynamic metal-metal friction at plastic stress levels
[DE88-011281] N88-29176
Considerations and measurements of latent-heat-storage salts for secondary thermal battery applications
[DE88-011091] N88-29213
Planarization of metal substrates for solar mirrors
[DE88-011492] N88-29214
Liquid metal thermal-electric converter electrode development
[DE88-009252] N88-29221
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230
A comparison of typical meteorological year solar radiation information with the SOLMET data base
[DE88-009242] N88-29247
An OKQPSK modem incorporating numerically controlled carrier synthesis
[DE88-009536] N88-29304
La2CuO(sub 4 + delta): A superconducting superoxide
[DE88-010325] N88-29578

Chemical kinetics of hydrogen and P(sub b) centers
[DE88-010526] N88-29594
Selective weathering of shocked minerals and chondritic enrichment of the Martian fines N88-29660
SANTA CATARINA UNIV., FLORIANOPOLIS (BRAZIL).
Thermodynamical, optical and X-rays studies of some thermotropic liquid crystals
[DE88-702301] N88-29590
SAO PAULO UNIV., SAO CARLOS (BRAZIL).
Preparation and testing of Nb-Zr and Nb-ZrO2 single crystals for deformation studies
[DE88-702798] N88-29613
SAO PAULO UNIV. (BRAZIL).
Effect of a laser field in the electron inelastic scattering into plasma fields
[DE88-702295] N88-29157
Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: Numerical and analytical results
[DE88-702747] N88-29473
Development of Nb-Ti multifilamentar superconducting wires
[DE88-702324] N88-29592
SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEX.
USAF hyperbaric animal transfer chamber system
[AD-A193633] N88-29265
SCIENCE APPLICATIONS INTERNATIONAL CORP., COLLEGE STATION, TEX.
Sea ice processes
[AD-A193960] N88-29262
SCIENTIFIC RESEARCH ASSOCIATES, INC., GLASTONBURY, CONN.
An efficient patched grid Navier-Stokes solution for multiple bodies, phase 1
[AD-A194166] N88-29110
SHEFFIELD UNIV. (ENGLAND).
Mapping of volcanic units at Alba Patera, Mars N88-29663
SIGMA RESEARCH, INC., REDMOND, WASH.
Signal processing software for ground penetrating radar, user's manual
[AD-A194286] N88-29059
SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MASS.
Analytical investigation of the dynamics of tethered constellations in earth orbit
[NASA-CR-179371] N88-28950
SOCIETE ANONYME BELGE DE CONSTRUCTIONS AERONAUTIQUES, BRUSSELS.
General operational and training visual concerns N88-29295
Future visual environment and concerns N88-29299
SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, CANNES (FRANCE).
Study of a safe attitude for the Infrared Space Observatory (ISO) during perigee pass
[SNIAS-881-440-113] N88-28954
The heat pipe network of TDF-1/TV-SAT. Review of the development at completion
[SNIAS-881-440-103] N88-29127
Development of a space deployable radiator using heat pipes
[SNIAS-881-440-104] N88-29128
SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, LES MUREAUX (FRANCE).
Ariane 5, HERMES and European vehicles for space station servicing
[SNIAS-881-422-102] N88-28943
SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, PARIS (FRANCE).
Contribution of expert systems to avionics advance. Application on AS30 laser weapon system
[SNIAS-881-320-103] N88-29449
SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, SAINT-MEDARD-EN-JALLES (FRANCE).
Nondestructive tests and high performance composite structures
[SNIAS-881-430-119] N88-28969
Contribution to the study of materials behavior in space environment
[SNIAS-881-430-104] N88-28977
Very high temperature materials for mechanical application
[SNIAS-881-430-108] N88-28978
The sol-gel synthesis of ceramics
[SNIAS-881-430-114] N88-29037
Al2O3-TiO2 and Al2TiO5 ceramic materials
[SNIAS-881-430-122] N88-29038
Results of the use of an automated electrical measuring instrument calibration system
[SNIAS-881-430-107] N88-29146
Nondestructive investigations for space use
[SNIAS-881-430-105] N88-29189
Plasma torch design codes package
[SNIAS-881-430-115] N88-29569
SOCIETE POUR L'EQUIPMENT DES VEHICULES, GOSSELIES (BELGIUM).
General operational and training visual concerns N88-29295
Future visual environment and concerns N88-29299
SOUTH CAROLINA UNIV., COLUMBIA.
Conjunctive measurement theory: Cognitive research prospects
[AD-A193627] N88-29277
Easy Bayes estimation for Rasch-type models
[AD-A193628] N88-29491
SOUTHAMPTON UNIV. (ENGLAND).
Experiments on the dissipation of sound by separated flow at an edge
[ISVR-TR-151] N88-29522
A comparison of simple analytical models for representing propeller aircraft structural and acoustic responses
[ISVR-TR-153] N88-29523
SOUTHERN METHODIST UNIV., DALLAS, TEX.
Laser induced chemical vapor epitaxial growth of gallium arsenide films
[AD-A194254] N88-29595
SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.
High hot-hardness gear lubricant evaluations, phase 2
[AD-A192309] N88-29017
Development of a test method to determine potential peroxide content in turbine fuels. Part 2
[AD-A192244] N88-29042
SPACE COMPUTER CORP., SANTA MONICA, CALIF.
Object discrimination via bulk temperature/velocity filtering, phase 1
[AD-A194533] N88-29487
SPACE DATA CORP., TEMPE, ARIZ.
Multi-sensory tracking mount control
[AD-A194675] N88-29339
SPACE TELESCOPE SCIENCE INST., BALTIMORE, MD.
Automated generation of spacecraft activity plans N88-29396
SPECTRA RESEARCH INST., ALBUQUERQUE, N. MEX.
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230
SPECTRA TECHNOLOGY, INC., BELLEVUE, WASH.
Linear thyratron
[AD-A194111] N88-29094
SPECTRAL SCIENCES, INC., BURLINGTON, MASS.
Progress on a Monte Carlo shuttle contamination model
[AD-A193694] N88-28945
SRI INTERNATIONAL CORP., MENLO PARK, CALIF.
Evaluation of a diffusion/trapping model for hydrogen ingress in high-strength alloys
[AD-A194301] N88-29008
Hierarchical organization for large, dynamic radio networks
[AD-A193942] N88-29067
STANFORD UNIV., CALIF.
The use of a surface acoustic wave technique to study the growth behavior of small cracks in a high strength steel alloy N88-29193
Cooperating knowledge-based systems
[NASA-CR-183109] N88-29327
More than a solar cycle of synoptic solar and coronal data: A video presentation
[NASA-CR-181459] N88-29708
STATE UNIV. OF NEW YORK, BUFFALO.
Electronic states of the Xe(sub n)HCl systems in gas and condensed phases
[AD-A193881] N88-28997
STATE UNIV. OF NEW YORK AT BUFFALO, AMHERST.
Multicriteria integer programming for problems involving linear and nonlinear utility functions
[AD-A194530] N88-29336
STOCKHOLM UNIV. (SWEDEN).
The Hilbert space of the open bosonic string
[USIP-88-02] N88-29628
STUTTGART UNIV. (WEST GERMANY).
Band pass with cavity resonators by use of three oscillation types
[ETN-88-92984] N88-29096
Theoretical and experimental investigations on the structure of stationary shock waves in gas particle dispersions
[ETN-88-92983] N88-29122
Muon-spin rotation experiment (micro + SR) on aluminum and indium after low temperature electron irradiation
[ETN-88-92985] N88-29517
SVERDRUP TECHNOLOGY, INC., ARNOLD AIR FORCE STATION, TENN.
Analysis of edge detection techniques for radiographic image measurement
[AD-A193650] N88-28961
SYRACUSE UNIV., N. Y.
The complexity of AI algorithms
[AD-A193494] N88-29438
On the design and optimization of distributed signal detection and parameter estimation systems
[AD-A193934] N88-29448

T

TECHNADYNE ENGINEERING CONSULTANTS, ALBUQUERQUE, N. MEX.
Development of an adjustable buoyancy balloon tracer of atmospheric motion. Phase 3: Refinement of the operational prototype system
[PB88-190764] N88-29230
TECHNION RESEARCH AND DEVELOPMENT FOUNDATION LTD., HAIFA (ISRAEL).
Stochastic game approach to guidance design
[AD-A194574] N88-29498
Cooperative effects and intrinsic optical bistability in collections of atoms
[AD-A193993] N88-29530
TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).
Classical separation, trailing-edge flows and buffeting N88-28874
Development of creep fracture modelling in ceramics
[PB88-202825] N88-29021
Dry adhesive friction of elastomers: A study of the fundamental mechanical aspects
[ETN-88-92903] N88-29036
Nonlinear vibrations of imperfect thin walled cylindrical shells
[ETN-88-92904] N88-29205
Implementation of a flexible link model in a designed robot system, using the finite element method
[ETN-88-92902] N88-29303
TECHNISCHE HOGESCHOOL TWENTE, ENSCHEDE (NETHERLANDS).
Investigations on periodically perturbed optical waveguides
[B8712725] N88-29548
TECHNISCHE UNIV., BERLIN (WEST GERMANY).
Rotation symmetric inside flow with diametric expansion resolution
[ILR-MITT-193] N88-29123
TECHNISCHE UNIV., BRUNSWICK (WEST GERMANY).
A contribution to the quantitative analysis of the influence of design parameters on the optimal design of passenger aircraft
[ETN-88-92979] N88-28912
Modeling of momentum transport of axially parallel turbulent flows in rod cascades
[ETN-88-92978] N88-29131
TECHNISCHE UNIV., HAMBURG (WEST GERMANY).
Relation between strength, creep and relaxation behavior in Cu and Al at room temperature
[ETN-88-92982] N88-29015
TECHNISCHE UNIV., MUNICH (WEST GERMANY).
Time minimal computation of feedback control schemes for optimal guidance problems used in space flight
[ETN-88-92989] N88-28953
Long-term behavior of energy production systems with the example of HELIOS and SYMPHONIE
[ETN-88-92988] N88-29223
TEL-AVIV UNIV. (ISRAEL).
Small scale mixing in the initial region of a jet
[AD-A193500] N88-28994
TELEDYNE BROWN ENGINEERING, HUNTSVILLE, ALA.
Software development without languages N88-29392
TEMPLE UNIV., PHILADELPHIA, PA.
Hydrogen concentration cells as converters of heat into electricity
[DE88-009662] N88-29218
TENNESSEE UNIV., KNOXVILLE.
Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system
[DE88-009714] N88-28960
Three-dimensional laser Doppler velocimeter studies of flow in a 90 deg curved duct having a square cross-section N88-29101
Optimization-driven machine-oriented motion measurement N88-29312
TENNESSEE UNIV. SPACE INST., TULLAHOMA.
Algebraic grid generation for fighter type aircraft N88-29320
Semantic based man-machine interface for real-time communication N88-29421
TEXAS A&M UNIV., COLLEGE STATION.
Investigation of helicopter rotor blade/wake interactive impulsive noise
[NASA-CR-177435] N88-28882

TEXAS UNIV., DALLAS.
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser
[AD-A193856] N88-29165
TOKYO UNIV., TANASHI (JAPAN).
Magnetic phase transitions in 90-K superconductors Ho1Ba2Cu3O(7-delta) and Gd1Ba2Cu3O(7-delta) observed by ZF-muon(+)SR
[DE88-752611] N88-29588
Resonant spin-flavor precession of solar and supernova neutrinos
[DE88-752604] N88-29707
TORONTO UNIV. (ONTARIO).
The effects of moisture loss and elevated temperature upon the material damping of fibre reinforced polymer matrix composites
[UTIAS-324] N88-28970
Tokamak plasma interaction with limiters
[UTIAS-325] N88-29566
TREC, INC., HUNTSVILLE, ALA.
Two dimensional convolute integers for machine vision and image recognition N88-29369
TRW DEFENSE AND SPACE SYSTEMS GROUP, HOUSTON, TEX.
Study of Plasma Motor Generator (PMG) tether system for orbit reboost
[NASA-CR-172074] N88-28949
TRW, INC., REDONDO BEACH, CALIF.
SCARES: A Spacecraft Control Anomaly Resolution Expert System N88-29381
TUFTS UNIV., MEDFORD, MASS.
Transport of organic vapors in multiphase polymer system
[AD-A194097] N88-29033

U

UNISEARCH ASSOCIATES, INC., CONCORD (ONTARIO).
The 1985-86 measurements with the tunable diode laser absorption spectrometer
[PB88-214002] N88-29226
UNITED TECHNOLOGIES CORP., EAST HARTFORD, CONN.
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Volume 3: Heat transfer data tabulation 65 percent axial spacing
[NASA-CR-179468] N88-28930
UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CONN.
An unsteady helicopter rotor: Fuselage interaction analysis
[NASA-CR-4178] N88-28880
UNIVERSIDAD NACIONAL DE CUYO, MENDOZA (ARGENTINA).
Phenomena of the ionic transport in the stress corrosion of metals
[DE88-702502] N88-29013
UNIVERSIDADE ESTADUAL DE CAMPINAS (BRAZIL).
Study of superconducting properties in some many valley semiconductors
[DE88-702325] N88-29593
UNIVERSIDADE FEDERAL DE SAO CARLOS (BRAZIL).
Hydrogen permeation through metallic foils
[DE88-702600] N88-29000
UNIVERSITAET DER BUNDESWEHR, NEUBIBERG (WEST GERMANY).
Automatic landing by computer vision
[ETN-88-92991] N88-28905
UNIVERSITY OF NORTHEAST LOUISIANA, MONROE.
The Martian sedimentary record N88-29669
Progress in determining the thickness and distribution of volcanic materials on Mars N88-29670
UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Unsteady water channel
[AD-A194231] N88-28884
The high temperature creep deformation of Si3N4-6Y2O3-2Al2O3
[NASA-CR-183204] N08-28981
UNIVERSITY OF THE WEST INDIES, MONA (JAMAICA).
Radioactivity as a means of nondestructive testing
[DE88-702778] N88-29188
UTAH UNIV., SALT LAKE CITY.
Currents induced in a human being for electromagnetic fields to 10 kHz-50 MHz
[AD-A191977] N88-29268

V

VANDERBILT UNIV., NASHVILLE, TENN.
Intelligent test integration system N88-29371
A generic expert system for materials processing in space N88-29376
Programming model for distributed intelligent systems N88-29390
VIRGINIA UNIV., CHARLOTTESVILLE.
Structural relationship between icosahedral and Frank-Kasper phases of Al-Li-Cu
[AD-A193768] N88-29011
Random-access algorithms for environments with capture
[AD-A194303] N88-29060
VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE (BELGIUM).
Modeling of large stall in axial compressors
[VKI-NT-164] N88-29124
Application of Particle Image Displacement Velocimetry (PIDV) to complex flows: Velocity field measurements in front of a heavy gas cloud
[VKI-TN-166] N88-29125

W

WASHINGTON STATE UNIV., PULLMAN.
Spectral characteristics and the extent of paleosols of the Palouse formation
[NASA-CR-180947] N88-29210
Investigation of the higher-order elements in the SAMSON2 code
[AD-A193638] N88-29465
WASHINGTON UNIV., SEATTLE.
J-integral measurement using moire interferometry
[AD-A193751] N88-29202
Surface composition of Mars: A Viking multispectral view N88-29655
WAYNE STATE UNIV., DETROIT, MICH.
Limiting distributions of non-linear vector functions of stationary Gaussian processes
[AD-A194569] N88-29488
WEIZMANN INST. OF SCIENCE, REHOVOTH (ISRAEL).
Quasi-liquid crystalline materials with special electro-optic properties
[AD-A194579] N88-29544
WESTINGHOUSE RESEARCH AND DEVELOPMENT CENTER, PITTSBURGH, PA.
Mathematical algorithms for approximate reasoning N88-29418
WISCONSIN UNIV., MADISON.
A limiting viscosity approach to the Riemann problem for materials exhibiting change of phase
[AD-A193477] N88-29103
Computation of the eigenvalues for perturbations of Poiseuille flow using a two-point boundary value method
[AD-A193479] N88-29104
An exponential decay estimate for the stationary perturbation of Poiseuille flow
[AD-A193480] N88-29105
A minitab macro for the Kaplan-Meier product limit estimator and the Tarone-Ware class of tests
[AD-A194298] N88-29331
On a class of functionals invariant under a Z(sup n) action
[AD-A193474] N88-29451
The construction of implicit and explicit solitary wave solutions of nonlinear partial differential equations
[AD-A193475] N88-29452
A minimax method for a class of Hamiltonian systems with singular potentials
[AD-A193478] N88-29453
Periodic solutions of perturbed superquadratic Hamiltonian systems
[AD-A194292] N88-29457
MACSYMA program for the painleve test of nonlinear ordinary and partial differential equations
[AD-A194293] N88-29458
On the periodic nonlinearity and the multiplicity of solutions
[AD-A194295] N88-29459
Exact lower confidence limits for the reliability of k of n systems for zero failures and nonconservativeness of the maximus method
[AD-A194299] N88-29485
Monotone recurrence relations, their Birkhoff orbits and topological entropy
[AD-A193481] N88-29504
Feedback stabilization of du/dt=Au + bf in Hilbert space when the normalization function is less than or equal to r
[AD-A193510] N88-29506
Numerical simulations of resistive magnetohydrodynamic instabilities in a poloidal divertor tokamak
[DE88-010768] N88-29559
An HVEM study of displacement cascade damage in Nb3Sn at 13 K
[DE88-009997] N88-29584

The kinematics of Milky Way halo gas N88-29648
WISCONSIN UNIV., MILWAUKEE.
Low temperature film growth of the oxides of zinc, aluminum and vanadium (and related systems, oxides of gold and germanium, nitrides of aluminum and tungsten) by reactive sputter deposition
[AD-A193497] N88-28986

Y

YALE UNIV., NEW HAVEN, CONN.
Hydrogen storage by molecular polyhydrides
[AD-A194207] N88-28989
High energy and high intensity laser effects on aerosols: Changes in droplet morphology, surrounding temperature and vapor concentration
[AD-A193825] N88-29184
Limits of pattern discrimination in human vision
[AD-A193449] N88-29273
Solving the symmetric tridiagonal eigenvalue problem on the hypercube
[AD-A193905] N88-29344
Systematic properties of clusters of galaxies in different cosmological scenarios N88-29646
What SNC meteorites tell us about Martian magmatism N88-29679

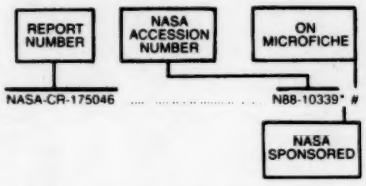
Typical Contract Number Index Listing

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

AF PROJ. 2567 ..... N88-28937
AF-AFOSR-0012-87 ..... N88-29005
AF-AFOSR-0024-85 ..... N88-29039
AF-AFOSR-0048-84 ..... N88-29113
AF-AFOSR-0064-85 ..... N88-28884
AF-AFOSR-0074-87 ..... N88-29114
AF-AFOSR-0076-87 ..... N88-29434
AF-AFOSR-0077-86 ..... N88-29273
AF-AFOSR-0079-86 ..... N88-29461
AF-AFOSR-0090-87 ..... N88-29633
AF-AFOSR-0101-87 ..... N88-29445
AF-AFOSR-0131-87 ..... N88-29596
AF-AFOSR-0160-84 ..... N88-29185
AF-AFOSR-0172-81 ..... N88-29506
AF-AFOSR-0202-87 ..... N88-29451
N88-29453
AF-AFOSR-0239-85 ..... N88-29103
AF-AFOSR-0243-86 ..... N88-28886
AF-AFOSR-0263-85 ..... N88-29452
N88-29458
AF-AFOSR-0270-85 ..... N88-29543
AF-AFOSR-0278-85 ..... N88-28994
AF-AFOSR-0313-84 ..... N88-29275
AF-AFOSR-0315-85 ..... N88-29442
N88-29496
AF-AFOSR-0315-86 ..... N88-29090
AF-AFOSR-0315-87 ..... N88-29508
AF-AFOSR-0334-84 ..... N88-28968
AF-AFOSR-0364-85 ..... N88-29288
AF-AFOSR-0374-83 ..... N88-28924
AF-AFOSR-1089-85 ..... N88-29429
AF-AFOSR-3055-86 ..... N88-29498
ARPA ORDER 4766 ..... N88-29087
BMFT-LFK-8531 ..... N88-28979
BMFT-LFL-83618 ..... N88-28932
BMFT-STU-8603/8 ..... N88-29224
BMVT-FOA-T/RF-31/D0037/D1332 ..... N88-29073
N88-29074
BMVT-T/RF-31/D0037/D1332 ..... N88-29075
DA PROJ. RR0-4204 ..... N88-29290
DA PROJ. 1L1-61102-BH-57 ..... N88-29087
N88-29596
DA PROJ. 1L1-61103-BH-57 ..... N88-29025
DA PROJ. 1L7-62733-AH-20 ..... N88-29017
DA PROJ. 2Q2-63731-A-792 ..... N88-29287
DA PROJ. 3E1-62787-A-879 ..... N88-29271
DA PROJ. 3M1-61102-BS-10 ..... N88-29062
DAAB07-87-C-F066 ..... N88-29166
DAAD07-87-C-0038 ..... N88-29339
DAAE07-86-C-R089 ..... N88-29302
DAAG29-83-G-0016 ..... N88-28885
DAAG29-83-K-0075 ..... N88-29546
DAAG29-83-K-0137 ..... N88-29033
DAAG29-83-K-0170 ..... N88-28975
DAAG29-84-K-0035 ..... N88-28989
DAAG29-84-K-0042 ..... N88-29067
DAAG29-84-K-0126 ..... N88-28966
DAAG29-84-K-0149 ..... N88-29117
DAAG29-84-K-0155 ..... N88-29029
DAAG29-84-K-0176 ..... N88-29009
DAAG29-85-C-0018 ..... N88-29209
DAAG29-85-K-0003 ..... N88-29194
N88-29201
DAAG29-85-K-0044 ..... N88-29636
DAAG29-85-K-0062 ..... N88-28995
DAAG29-85-K-0063 ..... N88-29164
DAAG29-85-K-0068 ..... N88-29028
DAAG29-85-K-0070 ..... N88-29340
DAAG29-85-K-0088 ..... N88-29443
DAAG29-85-K-0258 ..... N88-29139
DAAJ45-88-C-0011 ..... N88-29020
DAAK70-82-C-0001 ..... N88-29017
DAAK70-85-C-0007 ..... N88-29017
N88-29042
DAAK70-87-C-0043 ..... N88-29042
DAAL03-86-C-0016 ..... N88-29091
DAAL03-86-G-0201 ..... N88-29545
DAAL03-86-K-0040 ..... N88-28996
DAAL03-86-K-0171 ..... N88-29496
DAAL03-87-C-0010 ..... N88-29110
DAAL03-87-K-0028 ..... N88-29104
N88-29105
DAAL03-87-K-0036 ..... N88-29459
DAAL03-87-K-0043 ..... N88-29451
N88-29453
N88-29457
N88-29504
DAAL03-87-K-0057 ..... N88-29011
DAJA45-84-C-0052 ..... N88-29601
DAJA45-85-C-0015 ..... N88-29025
DAJA45-85-C-0020 ..... N88-29598
DAJA45-85-C-0030 ..... N88-29544
DAJA45-86-0049 ..... N88-29208
DAJA45-87-C-0032 ..... N88-28971
DAJA45-87-C-0038 ..... N88-29435
DAJA45-87-C-0040 ..... N88-29530
DAJA45-87-C-0051 ..... N88-28883
DAJA45-88-C-0003 ..... N88-29623
DAMD17-83-C-3025 ..... N88-29062
N88-29276
DE-AC02-76CH-00016 ..... N88-29572
N88-29586
DE-AC02-83CH-10093 ..... N88-29211
N88-29212
N88-29220
DE-AC02-84ER-40125 ..... N88-29621
DE-AC02-84ER-45048 ..... N88-29582
DE-AC03-76SF-00098 ..... N88-29138
N88-29217
N88-29558
N88-29571
N88-29581
DE-AC04-76DP-00789 ..... N88-29988
N88-29006
N88-29043
N88-29046
N88-29082
N88-29084
N88-29176
N88-29213
N88-29214
N88-29221
N88-29247
N88-29578
N88-29594
DE-AC04-76DR-00789 ..... N88-29304
DE-AC05-84OR-21400 ..... N88-28960
N88-29057
N88-29225
N88-29562
DE-AC05-84OT-21400 ..... N88-29173
DE-AC21-85MC-22074 ..... N88-29172
DE-FC02-85CH-10289 ..... N88-29211
DE-FC08-85DP-40200 ..... N88-29158
DE-FG01-85CE-15218 ..... N88-29216
DE-FG02-84ER-13261 ..... N88-29284
DE-FG02-85ER-40228 ..... N88-29538
DE-FG02-86ER-45252 ..... N88-29022
DE-FG02-86ER-53218 ..... N88-29559
DE-FG02-87ER-25035 ..... N88-29329
DE-FG02-87ER-45334 ..... N88-29587
DE-FG03-86ER-53220 ..... N88-29553
N88-29564
N88-29585
DE-FG05-86ER-45259 ..... N88-29565
DE-FG05-87ER-52147 ..... N88-29156
DE-MS79-86BP-92222 ..... N88-29171
DFG-HA-523/19-4 ..... N88-29123
DNA PROJ. U99-QMXM N88-29267
DNA001-83-C-0010 ..... N88-29267
DNA001-86-C-0138 ..... N88-29137
DRET-85-1404 ..... N88-29614
DRET-86-002-09 ..... N88-28976
DRET-87-002-018 ..... N88-29121
EEC-303-78-1 ..... N88-29228
EEC-85100004-FR-PUO-P1 ..... N88-29001
ESA-6467/85-NL-PP(SC) N88-29349
ESA-6880/86-HGE-I(SC) N88-29637
ESA-6988/86-NL-PP(SC) N88-29535
ESTEC-6358/85-NL-PP(SC) N88-28955
N88-28956
N88-28957
ESTEC-6842/86-NL-PH(SC) N88-28963
FFA-FMV-F-K-AU-2828 ..... N88-29126
FFA-SAAB-HU-2857 ..... N88-29521
FFA-STU-HU-2812 ..... N88-29519
N88-29520
N88-29521
F04611-87-C-0048 ..... N88-29649
F04701-85-C-0086 ..... N88-29018
N88-29527
F08635-84-C-0273 ..... N88-29482
F19628-83-C-0016 ..... N88-29032
F19628-84-C-0085 ..... N88-29063
F19628-85-C-0002 ..... N88-28934
N88-29155
F19628-85-C-0195 ..... N88-28945
F19628-86-C-0001 ..... N88-29529
F19628-86-K-0036 ..... N88-29237
F29601-83-K-0077 ..... N88-29144
F29601-85-K-0050 ..... N88-29465
F30602-81-C-0169 ..... N88-29446
F30602-81-C-0193 ..... N88-29438
F30602-85-C-0254 ..... N88-29447
F33615-83-C-3603 ..... N88-28922
F33615-84-C-0061 ..... N88-29187
F33615-84-C-2474 ..... N88-29094
F33615-84-C-3216 ..... N88-29204
F33615-84-C-5020 ..... N88-28974
F33615-84-C-5045 ..... N88-29199
F33615-84-K-1556 ..... N88-29086
F33615-85-C-3602 ..... N88-28921
N88-28922
F33615-85-C-5094 ..... N88-29034
F33615-86-C-3200 ..... N88-28887
F33615-86-C-3217 ..... N88-29004
F33615-86-C-5085 ..... N88-29600
F49620-85-C-0008 ..... N88-29490
F49620-85-C-0013 ..... N88-29236
F49620-85-C-0022 ..... N88-29555
F49620-85-C-0078 ..... N88-29079
F49620-85-C-0144 ..... N88-29456
N88-29460
N88-29482
N88-29488
F49620-85-K-0004 ..... N88-29143
N88-29278
F49620-86-C-0001 ..... N88-29441
F49620-86-C-0008 ..... N88-29249
F49620-86-C-0090 ..... N88-28889
F49620-86-C-0100 ..... N88-29439
F49620-86-C-0111 ..... N88-29442
F49620-86-C-0131 ..... N88-29143
F49620-87-C-0048 ..... N88-29055
F49620-87-C-0087 ..... N88-29154
GRI-5086-215-1413 ..... N88-29207
GRI-5086-294-1292 ..... N88-29215
MDA903-82-C-0531 ..... N88-29287
MDA903-84-C-0031 ..... N88-29161
N88-29335
N88-29494
N88-29495
MIPR-AT-E9-49-87 ..... N88-28940
MIPR-ATEC-48-47 ..... N88-28940
MIPR-FY7621-87-90042 ..... N88-28937
NAGW-533 ..... N88-28953
NAG1-336 ..... N88-29196

NAG1-444 ..... N88-29480
NAG1-513 ..... N88-29421
NAG1-613 ..... N88-29311
NAG1-626 ..... N88-29257
NAG1-635 ..... N88-28891
NAG1-709 ..... N88-29514
NAG1-768 ..... N88-29481
NAG3-685 ..... N88-28981
NAG5-842 ..... N88-29231
NAG9-108 ..... N88-29689
NASA ORDER C-90066-G N88-29195
NASW-4307 ..... N88-28900
N88-29003
N88-29041
N88-29098
N88-29134
N88-29135
N88-29182
N88-29183
N88-29618
N88-29631
NAS1-15325 ..... N88-28894
NAS1-16857 ..... N88-28915
N88-28916
N88-28983
NAS1-16984 ..... N88-29258
NAS1-17469 ..... N88-28880
NAS1-17666 ..... N88-29431
NAS1-17894 ..... N88-29115
NAS1-18066 ..... N88-28933
NAS1-18276 ..... N88-28861
NAS2-12448 ..... N88-28919
NAS3-23051 ..... N88-28928
NAS3-23717 ..... N88-28930
NAS3-24211 ..... N88-28929
NAS3-24222 ..... N88-28927
NAS3-24529 ..... N88-28917
NAS3-24564 ..... N88-29077
NAS5-28704 ..... N88-28947
NAS5-28758 ..... N88-29210
NAS5-30054 ..... N88-29136
NAS7-918 ..... N88-29095
N88-29328
NAS8-36192 ..... N88-29184
NAS8-36571 ..... N88-28964
N88-28965
NAS8-36606 ..... N88-28950
NAS9-17249 ..... N88-29044
N88-29045
NAS9-17515 ..... N88-29423
NAS9-17751 ..... N88-28949
NAS9-17878 ..... N88-28944
NCA2-OR-773-301 ..... N88-28882
NCC1-121 ..... N88-29116
NCC2-220 ..... N88-29327
NCC2-382 ..... N88-28896
NCC2-507 ..... N88-29106
NGR-05-020-559 ..... N88-29708
NPL-196/0152-A23 ..... N88-29148
NSF ATM-87-10102 ..... N88-29689
NSF DCR-85-3609 ..... N88-29341
NSF DCR-85-03609 ..... N88-29466
NSF DCR-85-05962 ..... N88-29347
N88-29471
NSF DMR-87-14665 ..... N88-29080
N88-29194
NSF DMS-85-11470 ..... N88-29496
NSF ECS-84-51523 ..... N88-29080
NSF ECS-85-05674 ..... N88-29496
NSF MCS-81-21940 ..... N88-29442
NSF MCS-83-02648 ..... N88-29346
N88-29348
N88-29470
N00014-79-C-0183 ..... N88-28990
N00014-80-C-0532 ..... N88-29031
N00014-80-C-0622 ..... N88-29468
N88-29469
N00014-81-C-0463 ..... N88-29597
N00014-82-K-0184 ..... N88-29344
N00014-82-K-0350 ..... N88-29024
N00014-83-K-0125 ..... N88-29333
N00014-83-K-0542 ..... N88-29442
N00014-84-C-0167 ..... N88-29450
N00014-84-K-0444 ..... N88-29345
N00014-85-C-0552 ..... N88-29153
N00014-85-C-6041 ..... N88-29118
N00014-85-C02520 ..... N88-29042
N00014-85-K-0168 ..... N88-29333
N00014-85-K-0187 ..... N88-29202
N00014-85-K-0222 ..... N88-29030
N00014-85-K-0452 ..... N88-29342
N00014-85-K-0461 ..... N88-29344
N00014-85-K-0474 ..... N88-29027
N00014-85-K-0609 ..... N88-29336
N00014-85-K-0643 ..... N88-29290
N00014-85-K-0809 ..... N88-29565
N00014-85-K-0898 ..... N88-28991
N00014-86-C-0233 ..... N88-29008
N00014-86-C-2454 ..... N88-29567
N00014-86-C-2488 ..... N88-29165
N00014-86-K-0043 ..... N88-28997
N00014-86-K-0204 ..... N88-29429
N88-29430
N00014-86-K-0280 ..... N88-28967
N00014-86-K-0309 ..... N88-29501
N00014-86-K-0316 ..... N88-28992
N88-28993
N88-29141
N00014-86-K-0345 ..... N88-29019
N00014-86-K-0381 ..... N88-29010
N00014-86-K-0680 ..... N88-29341
N88-29466
N00014-86-K-0706 ..... N88-29081
N00014-86-K-0740 ..... N88-29595
N00014-86-K-0742 ..... N88-29060
N00014-86-K-0817 ..... N88-29277
N88-29491
N00014-86-K-01014 ..... N88-29268
N00014-87-C-0173 ..... N88-29262
N00014-87-C-0340 ..... N88-29547
N00014-87-C-0728 ..... N88-29177
N00014-87-C-0746 ..... N88-29047
N00014-87-C-0765 ..... N88-29300
N00014-87-C-0801 ..... N88-29487
N00014-87-F-0007 ..... N88-29016
N00014-87-F-0066 ..... N88-29159
N88-29160
N00014-87-K-0036 ..... N88-28973
N00014-87-K-0277 ..... N88-29483
N00014-87-K-0467 ..... N88-29345
N88-29346
N88-29347
N88-29348
N88-29468
N88-29470
N88-29471
N00014-87-K-0481 ..... N88-29080
N88-29194
N88-29577
N00014-87-K-0517 ..... N88-29026
N00014-88-K-0134 ..... N88-29457
N00014-88-K-0170 ..... N88-29450
N88-29484
N00019-87-K-0467 ..... N88-29469
N00024-85-C-6041 ..... N88-29099
N00228-85-G-3247 ..... N88-29515
N00600-84-D-4171 ..... N88-28923
N62269-86-C-0278 ..... N88-29906
N62474-85-C-4953 ..... N88-29059
N66001-86-C-0438 ..... N88-29067
PROJ. RR0-4204 ..... N88-29277
N88-29483
N88-29491
PROJ. RR0-4206 ..... N88-29342
PROJ. R12-99 ..... N88-29262
S-S-28-7-86048 ..... N88-29521
SCEE-HER/86-14 ..... N88-29278
TO-87-57 ..... N88-28944
W-31-109-ENG-38 ..... N88-29107
N88-29432
N88-29561
N88-29583
N88-29584
W-7405-ENG-36 ..... N88-28948
N88-28987
N88-29083
N88-29197
N88-29510
N88-29537
N88-29554
N88-29560
N88-29580
N88-29638
W-7405-ENG-48 ..... N88-28984
N88-29248
N88-29552
N88-29579
N88-29644
W-31109-ENG-38 ..... N88-29639
ZWO-10-70-10 ..... N88-29513
474-74-10 ..... N88-28942
482-55-52 ..... N88-28959
505-33-43-09 ..... N88-28895
505-34-13-34 ..... N88-29258
505-45-13-02 ..... N88-29259
N88-29260
N88-29261
505-60-31-01 ..... N88-28894
505-61-01-02 ..... N88-28879
N88-28933
505-61-51 ..... N88-28880
N88-28882
505-62-01 ..... N88-29152
505-63-01 ..... N88-28960
505-63-21-01 ..... N88-28892
505-66-01-02 ..... N88-29489
506-40-11-06 ..... N88-28881
506-41-41 ..... N88-28966
506-43-21-04 ..... N88-28962
506-43-31-03 ..... N88-29115
506-96-21-05 ..... N88-29431
533-02-01-03 ..... N88-28891
533-04-11 ..... N88-28930
534-03-13-30 ..... N88-28983
535-03-01 ..... N88-28917
N88-28929
N88-29142
535-03-11 ..... N88-28918
535-07-01 ..... N88-29195
549-02-41-05 ..... N88-29328
551-54-24 ..... N88-29256
672-21-14-70 ..... N88-29234
679-40 ..... N88-29077
906-70-45-01 ..... N88-28949

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-86082 ..... N88-28918* #
A-88165 ..... N88-29455* #

ACEE-26-FR-3504 ..... N88-28983* #
ACEE-26-TR-3478-VOL-2 ..... N88-28915* #
ACEE-26-TR-3958A-VOL-3 ..... N88-28916* #

ACSC-88-570 ..... N88-28909 #
ACSC-88-0740 ..... N88-28888 #
ACSC-88-0780 ..... N88-29284 #
ACSC-88-1150 ..... N88-29332 #
ACSC-88-1485 ..... N88-29285 #
ACSC-88-1755 ..... N88-28897 #
ACSC-88-2135 ..... N88-28920 #
ACSC-88-2440 ..... N88-29499 #
ACSC-88-2445 ..... N88-28951 #
ACSC-88-2540 ..... N88-29500 #
ACSC-88-2690 ..... N88-28910 #

AD-A191177 ..... N88-29078 #
AD-A191219 ..... N88-29004 #
AD-A191975 ..... N88-29099 #
AD-A191977 ..... N88-29268 #
AD-A191979 ..... N88-29016 #
AD-A191980 ..... N88-29153 #
AD-A191991 ..... N88-28924 #
AD-A192244 ..... N88-29042 #
AD-A192289 ..... N88-28967 #
AD-A192301 ..... N88-29154 #
AD-A192309 ..... N88-29017 #
AD-A192328 ..... N88-29246 #
AD-A192374 ..... N88-28940 #
AD-A192376 ..... N88-28908 #
AD-A192378 ..... N88-29555 #
AD-A192399 ..... N88-29208 #
AD-A192446 ..... N88-29439 #
AD-A192506 ..... N88-29556 #
AD-A192589 ..... N88-29055 #
AD-A192604 ..... N88-29270 #
AD-A192605 ..... N88-29271 #
AD-A192676 ..... N88-29272 #
AD-A192892 ..... N88-29482 #
AD-A192946 ..... N88-29020 #
AD-A192952 ..... N88-28968 #
AD-A192958 ..... N88-29005 #
AD-A193072 ..... N88-29079 #
AD-A193107 ..... N88-29633 #
AD-A193172 ..... N88-29209 #
AD-A193205 ..... N88-29018 #
AD-A193341 ..... N88-29450 #
AD-A193404 ..... N88-29557 #
AD-A193430 ..... N88-29300 #
AD-A193447 ..... N88-29155 #
AD-A193449 ..... N88-29273 #
AD-A193456 ..... N88-28878 #
AD-A193460 ..... N88-29194 #
AD-A193461 ..... N88-29577 #
AD-A193462 ..... N88-29080 #
AD-A193463 ..... N88-29429 #
AD-A193465 ..... N88-29430 #
AD-A193467 ..... N88-29019 #

AD-A193473 ..... N88-29137 #
AD-A193474 ..... N88-29451 #
AD-A193475 ..... N88-29452 #
AD-A193477 ..... N88-29103 #
AD-A193478 ..... N88-29453 #
AD-A193479 ..... N88-29104 #
AD-A193480 ..... N88-29105 #
AD-A193481 ..... N88-29504 #
AD-A193485 ..... N88-29326 #
AD-A193494 ..... N88-29438 #
AD-A193497 ..... N88-28986 #
AD-A193499 ..... N88-29081 #
AD-A193500 ..... N88-28984 #
AD-A193510 ..... N88-29506 #
AD-A193512 ..... N88-29597 #
AD-A193513 ..... N88-28971 #
AD-A193521 ..... N88-29306 #
AD-A193523 ..... N88-29516 #
AD-A193524 ..... N88-28972 #
AD-A193526 ..... N88-29186 #
AD-A193528 ..... N88-29065 #
AD-A193532 ..... N88-29444 #
AD-A193547 ..... N88-29340 #
AD-A193558 ..... N88-29287 #
AD-A193559 ..... N88-29463 #
AD-A193560 ..... N88-29464 #
AD-A193564 ..... N88-28909 #
AD-A193580 ..... N88-29117 #
AD-A193593 ..... N88-29528 #
AD-A193594 ..... N88-29088 #
AD-A193615 ..... N88-29490 #
AD-A193620 ..... N88-29276 #
AD-A193623 ..... N88-29598 #
AD-A193627 ..... N88-29277 #
AD-A193628 ..... N88-29491 #
AD-A193633 ..... N88-29265 #
AD-A193634 ..... N88-29599 #
AD-A193638 ..... N88-29465 #
AD-A193640 ..... N88-29288 #
AD-A193642 ..... N88-29445 #
AD-A193643 ..... N88-29341 #
AD-A193645 ..... N88-29466 #
AD-A193650 ..... N88-28961 #
AD-A193669 ..... N88-29342 #
AD-A193673 ..... N88-29434 #
AD-A193675 ..... N88-29066 #
AD-A193677 ..... N88-29600 #
AD-A193678 ..... N88-28925 #
AD-A193694 ..... N88-28945 #
AD-A193697 ..... N88-29467 #
AD-A193698 ..... N88-29030 #
AD-A193700 ..... N88-28962 #
AD-A193710 ..... N88-28995 #
AD-A193711 ..... N88-29545 #
AD-A193713 ..... N88-29343 #
AD-A193733 ..... N88-29118 #
AD-A193745 ..... N88-29499 #
AD-A193751 ..... N88-29202 #
AD-A193758 ..... N88-29203 #
AD-A193759 ..... N88-29089 #
AD-A193766 ..... N88-29031 #
AD-A193767 ..... N88-29010 #
AD-A193768 ..... N88-29011 #
AD-A193773 ..... N88-28887 #
AD-A193778 ..... N88-28996 #
AD-A193779 ..... N88-29289 #
AD-A193786 ..... N88-29090 #
AD-A193792 ..... N88-29091 #
AD-A193793 ..... N88-29302 #
AD-A193794 ..... N88-29032 #
AD-A193798 ..... N88-28937 #
AD-A193805 ..... N88-29529 #
AD-A193811 ..... N88-29278 #
AD-A193815 ..... N88-29143 #
AD-A193819 ..... N88-28910 #
AD-A193825 ..... N88-29164 #
AD-A193827 ..... N88-29279 #
AD-A193849 ..... N88-28973 #
AD-A193856 ..... N88-29165 #
AD-A193857 ..... N88-29187 #
AD-A193864 ..... N88-29511 #
AD-A193865 ..... N88-29492 #
AD-A193871 ..... N88-29546 #

AD-A193873 ..... N88-29290 #
AD-A193881 ..... N88-28997 #
AD-A193891 ..... N88-29119 #
AD-A193892 ..... N88-28998 #
AD-A193898 ..... N88-29517 #
AD-A193901 ..... N88-29144 #
AD-A193902 ..... N88-29092 #
AD-A193905 ..... N88-29344 #
AD-A193934 ..... N88-29446 #
AD-A193935 ..... N88-29166 #
AD-A193936 ..... N88-29623 #
AD-A193940 ..... N88-29435 #
AD-A193942 ..... N88-29087 #
AD-A193943 ..... N88-29280 #
AD-A193958 ..... N88-29066 #
AD-A193959 ..... N88-29093 #
AD-A193960 ..... N88-29251 #
AD-A193961 ..... N88-29518 #
AD-A193980 ..... N88-29262 #
AD-A193993 ..... N88-29530 #
AD-A194002 ..... N88-29069 #
AD-A194025 ..... N88-29281 #
AD-A194026 ..... N88-29345 #
AD-A194027 ..... N88-29468 #
AD-A194028 ..... N88-29469 #
AD-A194029 ..... N88-29346 #
AD-A194030 ..... N88-29470 #
AD-A194031 ..... N88-29347 #
AD-A194032 ..... N88-29348 #
AD-A194034 ..... N88-29471 #
AD-A194037 ..... N88-29500 #
AD-A194040 ..... N88-28951 #
AD-A194057 ..... N88-28888 #
AD-A194065 ..... N88-29266 #
AD-A194066 ..... N88-28889 #
AD-A194097 ..... N88-29033 #
AD-A194100 ..... N88-29649 #
AD-A194101 ..... N88-29601 #
AD-A194102 ..... N88-29267 #
AD-A194104 ..... N88-29447 #
AD-A194107 ..... N88-29448 #
AD-A194111 ..... N88-29094 #
AD-A194113 ..... N88-28974 #
AD-A194114 ..... N88-29034 #
AD-A194115 ..... N88-29204 #
AD-A194116 ..... N88-29547 #
AD-A194118 ..... N88-29567 #
AD-A194127 ..... N88-29501 #
AD-A194134 ..... N88-29240 #
AD-A194136 ..... N88-28975 #
AD-A194150 ..... N88-29502 #
AD-A194153 ..... N88-29058 #
AD-A194162 ..... N88-29024 #
AD-A194166 ..... N88-29110 #
AD-A194191 ..... N88-28883 #
AD-A194205 ..... N88-29236 #
AD-A194207 ..... N88-28999 #
AD-A194212 ..... N88-29483 #
AD-A194214 ..... N88-29159 #
AD-A194215 ..... N88-29484 #
AD-A194217 ..... N88-29160 #
AD-A194223 ..... N88-29199 #
AD-A194224 ..... N88-29086 #
AD-A194231 ..... N88-28884 #
AD-A194236 ..... N88-29039 #
AD-A194237 ..... N88-29275 #
AD-A194240 ..... N88-29493 #
AD-A194246 ..... N88-29237 #
AD-A194249 ..... N88-29330 #
AD-A194250 ..... N88-29441 #
AD-A194254 ..... N88-29595 #
AD-A194264 ..... N88-29025 #
AD-A194265 ..... N88-28885 #
AD-A194269 ..... N88-29139 #
AD-A194286 ..... N88-29059 #
AD-A194290 ..... N88-29456 #
AD-A194292 ..... N88-29457 #
AD-A194293 ..... N88-29458 #
AD-A194295 ..... N88-29459 #
AD-A194298 ..... N88-29331 #
AD-A194299 ..... N88-29485 #
AD-A194301 ..... N88-29008 #
AD-A194303 ..... N88-29060 #

AD-A194308 ..... N88-28990 #
AD-A194339 ..... N88-28901 #
AD-A194348 ..... N88-28991 #
AD-A194356 ..... N88-29494 #
AD-A194357 ..... N88-29495 #
AD-A194358 ..... N88-29161 #
AD-A194361 ..... N88-29433 #
AD-A194363 ..... N88-29284 #
AD-A194367 ..... N88-29177 #
AD-A194371 ..... N88-29140 #
AD-A194407 ..... N88-29332 #
AD-A194408 ..... N88-28992 #
AD-A194409 ..... N88-28993 #
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AD-A194437 ..... N88-29141 #
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AD-A194458 ..... N88-28902 #
AD-A194462 ..... N88-28897 #
AD-A194476 ..... N88-29061 #
AD-A194477 ..... N88-29334 #
AD-A194479 ..... N88-29162 #
AD-A194480 ..... N88-29335 #
AD-A194481 ..... N88-29111 #
AD-A194484 ..... N88-29486 #
AD-A194486 ..... N88-29200 #
AD-A194487 ..... N88-29542 #
AD-A194490 ..... N88-29112 #
AD-A194493 ..... N88-29163 #
AD-A194498 ..... N88-28920 #
AD-A194505 ..... N88-29238 #
AD-A194506 ..... N88-29285 #
AD-A194530 ..... N88-29336 #
AD-A194533 ..... N88-29487 #
AD-A194534 ..... N88-29496 #
AD-A194535 ..... N88-29442 #
AD-A194538 ..... N88-29026 #
AD-A194544 ..... N88-29497 #
AD-A194553 ..... N88-28934 #
AD-A194556 ..... N88-29047 #
AD-A194560 ..... N88-29543 #
AD-A194569 ..... N88-29488 #
AD-A194570 ..... N88-29460 #
AD-A194574 ..... N88-29498 #
AD-A194579 ..... N88-29544 #
AD-A194583 ..... N88-29113 #
AD-A194594 ..... N88-29596 #
AD-A194595 ..... N88-29301 #
AD-A194601 ..... N88-28921 #
AD-A194602 ..... N88-28922 #
AD-A194609 ..... N88-29708* #
AD-A194605 ..... N88-28923 #
AD-A194611 ..... N88-29527 #
AD-A194613 ..... N88-29062 #
AD-A194614 ..... N88-29063 #
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AD-A194624 ..... N88-28903 #
AD-A194625 ..... N88-28941 #
AD-A194650 ..... N88-28886 #
AD-A194654 ..... N88-29337 #
AD-A194656 ..... N88-29338 #
AD-A194658 ..... N88-29222 #
AD-A194666 ..... N88-28904 #
AD-A194669 ..... N88-29165 #
AD-A194670 ..... N88-29239 #
AD-A194671 ..... N88-29461 #
AD-A194674 ..... N88-29565 #
AD-A194675 ..... N88-29339 #
AD-A194677 ..... N88-29009 #
AD-A194685 ..... N88-29462 #
AD-A194697 ..... N88-29201 #
AD-A194701 ..... N88-29249 #
AD-A194713 ..... N88-29027 #
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AD-A194717 ..... N88-29028 #
AD-A194718 ..... N88-29443 #
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AD-A194737 ..... N88-28936 #
AD-A194753 ..... N88-29286 #
AD-A194783 ..... N88-29087 #
AD-A194788 ..... N88-29515 #
AD-A194775 ..... N88-29114 #
AD-A194777 ..... N88-29274 #

AD-E500981 ..... N88-29161 #
AD-E500983 ..... N88-29494 #
AD-E500970 ..... N88-29495 #
AD-E500985 ..... N88-29061 #
AD-E500965 ..... N88-29162 #
AD-E500965 ..... N88-29334 #
AD-E500985 ..... N88-29335 #
AD-E801594 ..... N88-29017 #
AD-E801594 ..... N88-29246 #
AD-E801635 ..... N88-29462 #

AEDC-TR-87-37 ..... N88-28962 #
AEDC-TR-87-39 ..... N88-28961 #

AERONOMICA-ACTA-A-324-1988 ..... N88-29228
AERONOMICA-ACTA-A-327-1988 ..... N88-29243
AERONOMICA-ACTA-A-328-1988 ..... N88-29709

AES-8609709F-1 ..... N88-29004 #

AFAL-TR-88-007 ..... N88-29649 #
AFAL-TR-88-030 ..... N88-29203 #

AFATL-TR-87-73 ..... N88-29462 #
AFATL-TR-88-14 ..... N88-28937 #

AFGL-ERP-976 ..... N88-29240 #

AFGL-TR-87-0189 ..... N88-29240 #
AFGL-TR-88-0029 ..... N88-28945 #
AFGL-TR-88-0042 ..... N88-29237 #
AFGL-TR-88-0102 ..... N88-29063 #
AFGL-TR-88-0110 ..... N88-29239 #

AFHRL-TP-87-37 ..... N88-29187 #
AFHRL-TP-87-61 ..... N88-29286 #

AFIT/DS/AA/88-2 ..... N88-28931 #

AFIT/GCS/ENG/88J-1 ..... N88-29433 #

AFIT/GE/ENG/87D-11 ..... N88-28941 #
AFIT/GE/ENG/87D-12 ..... N88-28903 #
AFIT/GE/ENG/87D-15 ..... N88-29064 #

AFIT/GNE/ENP/88M-8 ..... N88-29539 #

AFL-88-1-73 ..... N88-29114 #

AFOSR-87-2024TR ..... N88-29439 #
AFOSR-88-0092TR ..... N88-29055 #
AFOSR-88-0096TR ..... N88-29154 #
AFOSR-88-0097TR ..... N88-28924 #
AFOSR-88-0275TR ..... N88-29079 #
AFOSR-88-0280TR ..... N88-28968 #
AFOSR-88-0305TR ..... N88-29005 #
AFOSR-88-0344TR ..... N88-29278 #
AFOSR-88-0351TR ..... N88-29456 #
AFOSR-88-0359TR ..... N88-29482 #
AFOSR-88-0364TR ..... N88-29143 #
AFOSR-88-0375TR ..... N88-29273 #
AFOSR-88-0382TR ..... N88-29555 #
AFOSR-88-0389TR ..... N88-29442 #
AFOSR-88-0393TR ..... N88-29496 #
AFOSR-88-0397TR ..... N88-29185 #
AFOSR-88-0401TR ..... N88-29490 #
AFOSR-88-0415TR ..... N88-28886 #
AFOSR-88-0418TR ..... N88-29488 #
AFOSR-88-0419TR ..... N88-29460 #
AFOSR-88-0437TR ..... N88-29445 #
AFOSR-88-0439TR ..... N88-29461 #
AFOSR-88-0448TR ..... N88-29113 #
AFOSR-88-0450TR ..... N88-29441 #
AFOSR-88-0451TR ..... N88-29543 #
AFOSR-88-0452TR ..... N88-29596 #
AFOSR-88-0461TR ..... N88-29275 #
AFOSR-88-0463TR ..... N88-29114 #
AFOSR-88-0465TR ..... N88-29039 #
AFOSR-88-0466TR ..... N88-28884 #
AFOSR-88-0484TR ..... N88-28889 #
AFOSR-88-0551TR ..... N88-29288 #
AFOSR-88-0558TR ..... N88-29434 #
AFOSR-88-0572TR ..... N88-29633 #

AFWAL-TR-86-17 ..... N88-29144 #
AFWAL-TR-87-1131 ..... N88-29086 #
AFWAL-TR-87-1190 ..... N88-29236 #
AFWAL-TR-87-2080 ..... N88-29094 #
AFWAL-TR-87-3055-VOL-2 ..... N88-28921 #
AFWAL-TR-87-3055-VOL-5 ..... N88-28922 #
AFWAL-TR-87-3059 ..... N88-29004 #
AFWAL-TR-87-3107 ..... N88-28887 #
AFWAL-TR-87-4082 ..... N88-29034 #
AFWAL-TR-87-4127 ..... N88-28974 #
AFWAL-TR-87-4133 ..... N88-29600 #
AFWAL-TR-87-4134 ..... N88-29199 #

AFWL-TR-86-85 ..... N88-29485 #
AFWL-TR-87-54 ..... N88-29092 #
AFWL-TR-87-71 ..... N88-29162 #
AFWL-TR-87-73 ..... N88-29163 #
AFWL-TR-87-99 ..... N88-29204 #

AGARD-AG-309 ..... N88-29313 #

AGARD-AR-224 ..... N88-28857 #
AGARD-AR-254 ..... N88-28893 #

AGARD-LS-156 ..... N88-29291 #

AGARD-R-766 ..... N88-28926 #

ANL-8010091 ..... N88-29639 #

ANL/FPP/TM-221 ..... N88-29561 #

ARCCB-MR-88014 ..... N88-29483 #

ARCCB-TR-88010 ..... N88-29484 #
ARCCB-TR-88013 ..... N88-29448 #

ARE-TM(UHA)-88504 ..... N88-29475 #

ARI-RN-88-13 ..... N88-29287 #

ARL/PSU/TR-88-001 ..... N88-29099 #
ARL/PSU/TR-88-002 ..... N88-29118 #

ARO-19750.7-PH ..... N88-29546 #
ARO-20252.2-EG-F ..... N88-28885 #
ARO-20485.7-CH ..... N88-29033 #
ARO-20614.1-EG ..... N88-29975 #
ARO-20770.2-CH ..... N88-28989 #
ARO-20948.10-EL ..... N88-29067 #
ARO-20987.4-MS ..... N88-29009 #
ARO-21334.19-MS ..... N88-28986 #
ARO-21371.14-MA ..... N88-29117 #
ARO-21382.8-MA ..... N88-29443 #
ARO-21719.15-MA ..... N88-29340 #
ARO-21826.15-EL ..... N88-29836 #
ARO-21875.10-MS ..... N88-29029 #
ARO-22109.6-CH ..... N88-29028 #
ARO-22306.12-EG ..... N88-29201 #
ARO-22362.2-CH ..... N88-28995 #
ARO-22517.21-GS ..... N88-29164 #
ARO-22741.3-CH ..... N88-29996 #
ARO-23262.1-PH-A ..... N88-29139 #
ARO-23306.157-MA ..... N88-29209 #
ARO-23444.1-PH ..... N88-29091 #
ARO-24122.1-MS ..... N88-29011 #
ARO-24827.1-PH-VIE ..... N88-29545 #
ARO-25053.1-EG-SBI ..... N88-29110 #

ATC-156 ..... N88-28934 #

AVF-VSR-110.1087 ..... N88-29326 #

AVF-87-04-09-VRX ..... N88-29326 #

BFLRF-242 ..... N88-29017 #
BFLRF-243-PT-2 ..... N88-29042 #

BNL-40934 ..... N88-29572 #
BNL-41289 ..... N88-29586 #

BRA-88-W030R ..... N88-29567 #

BRL-CR-594 ..... N88-28998 #

BRL-MR-3649-PT-1 ..... N88-29467 #
BRL-MR-3657 ..... N88-29119 #

BR105967 ..... N88-29475 #
BR106050 ..... N88-29350 #
BR106077 ..... N88-29097 #
BR106143 ..... N88-29436 #
BR106199 ..... N88-28906 #
BR106200 ..... N88-29309 #
BR106213 ..... N88-29308 #
BR106214 ..... N88-29307 #
BR106572 ..... N88-29549 #

B8679671 ..... N88-29534 #
B8681469 ..... N88-29532 #
B8681480 ..... N88-29474 #
B8681488 ..... N88-29615 #
B8705564 ..... N88-29533 #
B8705589 ..... N88-29001 #
B8712725 ..... N88-29548 #
B8803517 ..... N88-29509 #
B8805297 ..... N88-29536 #
B8811118 ..... N88-29513 #

CAA-PAPER-87017 ..... N88-28898

CAA-RP-87-3 ..... N88-29343 #

CAA-1/88 ..... N88-28907

CBPF-NF-034/87 ..... N88-29712 #
CBPF-NF-039/87 ..... N88-29531 #
CBPF-NF-050/87 ..... N88-29454 #
CBPF-NF-056/87 ..... N88-29622 #
CBPF-NF-060/87 ..... N88-29505 #

CERN-87-13 ..... N88-29085 #

CERT-RSF-QA-17/5005-AYD ..... N88-29121 #

CERT-2/1355-MO ..... N88-28976 #
CERT-422000/RF ..... N88-29614 #

CMS-TSR-88-1 ..... N88-29451 #
CMS-TSR-88-2 ..... N88-29452 #
CMS-TSR-88-6 ..... N88-29103 #
CMS-TSR-88-7 ..... N88-29506 #
CMS-TSR-88-8 ..... N88-29453 #
CMS-TSR-88-9 ..... N88-29104 #
CMS-TSR-88-10 ..... N88-29105 #
CMS-TSR-88-19 ..... N88-29459 #
CMS-TSR-88-21 ..... N88-29458 #
CMS-TSR-88-23 ..... N88-29457 #
CMS-TSR-88-24 ..... N88-29485 #
CMS-TSR-88-25 ..... N88-29504 #
CMS-TSR-88-26 ..... N88-29331 #

CNEA-NT-16/86 ..... N88-29013 #

CNEA-PMTM/T-6 ..... N88-29013 #

CONF-870594-1-REV-1 ..... N88-29364 #
CONF-871055-7 ..... N88-29138 #
CONF-871111-1 ..... N88-29217 #
CONF-880178-7 ..... N88-29537 #
CONF-880372-4 ..... N88-28987 #
CONF-880385-1 ..... N88-29225 #
CONF-880397-1-REV-1 ..... N88-29552 #
CONF-880408 ..... N88-29583 #
CONF-880408-4 ..... N88-29572 #
CONF-880408-22 ..... N88-29583 #
CONF-880466-3 ..... N88-29586 #
CONF-880512-6 ..... N88-29562 #
CONF-880546-9 ..... N88-29554 #
CONF-880549-1 ..... N88-29571 #
CONF-880565-3 ..... N88-29083 #
CONF-880567 ..... N88-29432 #
CONF-880567-5 ..... N88-29432 #
CONF-880579-6 ..... N88-29578 #
CONF-880602-1 ..... N88-29043 #
CONF-880613-10 ..... N88-29584 #
CONF-880681-1 ..... N88-29197 #
CONF-880687-5 ..... N88-29558 #
CONF-880702-5 ..... N88-28980 #
CONF-880702-12 ..... N88-29220 #
CONF-880703-1 ..... N88-29510 #
CONF-880724-7 ..... N88-29006 #
CONF-880728-1 ..... N88-29638 #
CONF-880730-1 ..... N88-29082 #
CONF-880737-1 ..... N88-29580 #
CONF-880750-3 ..... N88-29046 #
CONF-880752-3 ..... N88-29057 #
CONF-8809282 ..... N88-29186 #
CONF-8809421 ..... N88-28999 #
CONF-8809421 ..... N88-29000 #
CONF-8810317 ..... N88-29007 #
CONF-8810317 ..... N88-29174 #
CONF-8810317 ..... N88-29198 #
CONF-8708110-38 ..... N88-29579 #
CONF-8710277 ..... N88-29613 #
CONF-8803113-1 ..... N88-29644 #
CONF-8804114-4 ..... N88-29214 #
CONF-8805106-1 ..... N88-29107 #
CONF-8805118-1 ..... N88-29594 #
CONF-8805132-5 ..... N88-29084 #
CONF-8806127-1 ..... N88-29213 #
CONF-8806138-1 ..... N88-28988 #

CRC-APRAC-AP-10 ..... N88-29226 #

CRC-1428 ..... N88-29069 #

CRI/FR/HOL-C/1/87 ..... N88-29349 #

CRINC-FRL-730-1 ..... N88-28891* #

CS-TR-105-87-REV ..... N88-29345 #
CS-TR-106-87 ..... N88-29469 #
CS-TR-107-87 ..... N88-29466 #
CS-TR-108-87 ..... N88-29346 #
CS-TR-109-87 ..... N88-29470 #
CS-TR-111-87 ..... N88-29348 #
CS-TR-118-87 ..... N88-29471 #
CS-TR-154-88 ..... N88-29347 #

CSDG-87-1 ..... N88-29429 #
CSDG-87-4 ..... N88-29430 #

CSSA-ASTRO-87-22 ..... N88-29708* #

CTI-8601 ..... N88-28908 #

CU-CS-384-88 ..... N88-29342 #

CU-PG-MDA-SY-0005 ..... N88-29637 #

CUMER-87-2 ..... N88-28967 #

DE88-001029 ..... N88-29172 #
DE88-001136 ..... N88-29212 #
DE88-001144 ..... N88-29211 #
DE88-001161 ..... N88-29220 #
DE88-002265 ..... N88-29043 #
DE88-004395 ..... N88-28984 #
DE88-004686 ..... N88-29006 #
DE88-005392 ..... N88-29636 #
DE88-005446 ..... N88-29571 #
DE88-006102 ..... N88-29082 #
DE88-006446 ..... N88-29580 #
DE88-006458 ..... N88-29197 #
DE88-007383 ..... N88-29572 #
DE88-007820 ..... N88-29083 #
DE88-008085 ..... N88-29158 #
DE88-008249 ..... N88-29558 #
DE88-008368 ..... N88-29225 #
DE88-008403 ..... N88-29581 #
DE88-008493 ..... N88-29171 #
DE88-008580 ..... N88-29582 #
DE88-008802 ..... N88-29046 #
DE88-008931 ..... N88-29553 #
DE88-008934 ..... N88-29564 #
DE88-009066 ..... N88-29173 #
DE88-009242 ..... N88-29247 #
DE88-009252 ..... N88-29221 #
DE88-009291 ..... N88-29264 #
DE88-009536 ..... N88-29304 #
DE88-009682 ..... N88-29216 #
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DE88-009830 ..... N88-29552 #
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DE88-009995 ..... N88-29107 #
DE88-009997 ..... N88-29584 #
DE88-010091 ..... N88-29639 #
DE88-010202 ..... N88-29329 #
DE88-010247 ..... N88-29585 #
DE88-010325 ..... N88-29578 #
DE88-010416 ..... N88-29246 #
DE88-010528 ..... N88-29594 #
DE88-010564 ..... N88-29022 #
DE88-010788 ..... N88-29559 #
DE88-010780 ..... N88-29217 #
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DE88-011571 ..... N88-29587 #
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DE88-011606 ..... N88-29538 #
DE88-011627 ..... N88-29156 #
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DE88-011725 ..... N88-29644 #
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DE88-701500 ..... N88-29570 #
DE88-701619 ..... N88-29198 #
DE88-701621 ..... N88-29174 #
DE88-701623 ..... N88-29007 #
DE88-701645 ..... N88-29710 #
DE88-701647 ..... N88-29705 #
DE88-701833 ..... N88-29526 #
DE88-701837 ..... N88-29219 #
DE88-701889 ..... N88-29503 #
DE88-702017 ..... N88-29573 #
DE88-702044 ..... N88-29525 #
DE88-702050 ..... N88-29574 #
DE88-702060 ..... N88-29576 #
DE88-702138 ..... N88-29620 #
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DE88-702301 ..... N88-29590 #
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DE88-702324 ..... N88-29592 #

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DE88-702387 ..... N88-29056 #
DE88-702459 ..... N88-29232 #
DE88-702464 ..... N88-29563 #
DE88-702492 ..... N88-29712 #
DE88-702494 ..... N88-29531 #
DE88-702502 ..... N88-29013 #
DE88-702535 ..... N88-29120 #
DE88-702539 ..... N88-29035 #
DE88-702544 ..... N88-29167 #
DE88-702549 ..... N88-29603 #
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DE88-702599 ..... N88-28999 #
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DE88-702682 ..... N88-29605 #
DE88-702686 ..... N88-29606 #
DE88-702687 ..... N88-29168 #
DE88-702688 ..... N88-29650 #
DE88-702691 ..... N88-29607 #
DE88-702694 ..... N88-29508 #
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DE88-702735 ..... N88-29472 #
DE88-702737 ..... N88-29612 #
DE88-702742 ..... N88-29253 #
DE88-702743 ..... N88-29254 #
DE88-702747 ..... N88-29473 #
DE88-702778 ..... N88-29188 #
DE88-702798 ..... N88-29613 #
DE88-752310 ..... N88-29550 #
DE88-752553 ..... N88-29706 #
DE88-752604 ..... N88-29707 #
DE88-752611 ..... N88-29588 #
DE88-752629 ..... N88-29023 #
DE88-752620 ..... N88-29218 #
DE88-752662 ..... N88-29049 #
DE88-753424 ..... N88-29589 #
DE88-753434 ..... N88-29642 #

DFVLR-AVA-IB-227-87-A-15 ..... N88-29129 #

DFVLR-FB-86-51 ..... N88-29245 #
DFVLR-FB-87-19 ..... N88-29189 #
DFVLR-FB-88-02 ..... N88-28952 #
DFVLR-FB-88-06 ..... N88-28890 #
DFVLR-FB-88-11-PT-1 ..... N88-29241 #
DFVLR-FB-88-12-PT-2 ..... N88-29242 #
DFVLR-FB-88-15 ..... N88-28911 #

DFVLR-MITT-86-18 ..... N88-29255 #
DFVLR-MITT-87-13 ..... N88-28913 #

DGT-33061 ..... N88-29535 #

DMS-DB-02-VOL-2-PT-1 ..... N88-28881* #

DNA-TR-87-159 ..... N88-29267 #
DNA-TR-87-164 ..... N88-29137 #

DOE/BP-92222/1 ..... N88-29171 #

DOE/CE-15218/T1 ..... N88-29216 #

DOE/DP-40200/86-VOL-33 ..... N88-29158 #

DOE/ER-13261/2 ..... N88-29264 #
DOE/ER-25035/1 ..... N88-29329 #
DOE/ER-40125/14 ..... N88-29621 #
DOE/ER-40228/T1 ..... N88-29538 #
DOE/ER-45048/1 ..... N88-29582 #
DOE/ER-45252/T2 ..... N88-29022 #
DOE/ER-45259/4 ..... N88-29585 #
DOE/ER-45334/1 ..... N88-29587 #
DOE/ER-52147/1 ..... N88-29156 #
DOE/ER-53218/120 ..... N88-29559 #

DOE/MC-22074/2533 ..... N88-29172 #

DOE/NBB-0084 ..... N88-29248 #

DOT/FAA/CT-87/19 ..... N88-28919* #

DOT/FAA/PS-87/1 ..... N88-28934 #

D6-52511 ..... N88-28894* #
D600-11313-1 ..... N88-28917* #

E-3187 ..... N88-29077* #
E-3904 ..... N88-28942* #
E-4131-1 ..... N88-29142* #
E-4194 ..... N88-29195* #
E-4253 ..... N88-28980* #
E-4297 ..... N88-29152* #
E-4310 ..... N88-28959* #
E-4336 ..... N88-28966* #

ECE-TR-87-1-1 ..... N88-29429 #
ECE-TR-87-1-3 ..... N88-29430 #

EEI-87-174 ..... N88-28944* #

EMA-85-R-02 ..... N88-29256* #

EOARD-TR-88-03 ..... N88-29090 #

EPA-600/3-88-015 ..... N88-29230 #

ESA-BR-34 ..... N88-29713 #

ESA-CR(P)-2553 ..... N88-29535 #
ESA-CR(P)-2554 ..... N88-29637 #
ESA-CR(P)-2555-VOL-1 ..... N88-28955 #
ESA-CR(P)-2555-VOL-2 ..... N88-28956 #
ESA-CR(P)-2555-VOL-3 ..... N88-28957 #
ESA-CR(P)-2556 ..... N88-28963 #
ESA-CR(P)-2559 ..... N88-29349 #

ESA-PSS-01-70-ISSUE-3 ..... N88-29190 #

ESA-TT-1060 ..... N88-29245 #
ESA-TT-1085 ..... N88-29255 #
ESA-TT-1090 ..... N88-29189 #
ESA-TT-1099 ..... N88-28913 #

ESD-TR-88-119 ..... N88-29155 #

ETL-R-137 ..... N88-28904 #
ETL-R-140 ..... N88-29140 #

ETL-88002-TR ..... N88-29268 #

ETN-88-92653 ..... N88-28898
ETN-88-92720 ..... N88-29124 #
ETN-88-92721 ..... N88-29125 #
ETN-88-92722 ..... N88-29228
ETN-88-92723 ..... N88-29243
ETN-88-92724 ..... N88-29709
ETN-88-92775 ..... N88-29535 #
ETN-88-92776 ..... N88-29637 #
ETN-88-92777 ..... N88-29713 #
ETN-88-92807 ..... N88-29126 #
ETN-88-92808 ..... N88-29519 #
ETN-88-92809 ..... N88-29520 #
ETN-88-92810 ..... N88-29521 #
ETN-88-92811 ..... N88-29244 #
ETN-88-92812 ..... N88-29628 #
ETN-88-92823 ..... N88-29522 #
ETN-88-92824 ..... N88-29523 #
ETN-88-92832 ..... N88-29475 #
ETN-88-92833 ..... N88-29476 #
ETN-88-92834 ..... N88-29568 #
ETN-88-92845 ..... N88-29449 #
ETN-88-92846 ..... N88-28943 #
ETN-88-92852 ..... N88-28977 #
ETN-88-92853 ..... N88-29189 #
ETN-88-92854 ..... N88-28978 #
ETN-88-92855 ..... N88-29146 #
ETN-88-92862 ..... N88-29037 #
ETN-88-92863 ..... N88-29569 #
ETN-88-92867 ..... N88-28969 #
ETN-88-92869 ..... N88-29038 #
ETN-88-92873 ..... N88-29127 #
ETN-88-92874 ..... N88-29128 #
ETN-88-92877 ..... N88-28954 #
ETN-88-92887 ..... N88-29282 #
ETN-88-92888 ..... N88-28976 #
ETN-88-92889 ..... N88-29121 #
ETN-88-92890 ..... N88-29614 #
ETN-88-92892 ..... N88-29536 #
ETN-88-92893 ..... N88-29548 #
ETN-88-92894 ..... N88-29509 #
ETN-88-92895 ..... N88-29615 #
ETN-88-92896 ..... N88-29474 #
ETN-88-92897 ..... N88-29001 #
ETN-88-92898 ..... N88-29532 #
ETN-88-92899 ..... N88-29533 #
ETN-88-92900 ..... N88-29534 #
ETN-88-92901 ..... N88-29513 #
ETN-88-92902 ..... N88-29303 #
ETN-88-92903 ..... N88-29036 #
ETN-88-92904 ..... N88-29205 #
ETN-88-92905 ..... N88-29714 #
ETN-88-92906 ..... N88-29283 #
ETN-88-92907 ..... N88-29477 #
ETN-88-92908 ..... N88-29478 #
ETN-88-92911 ..... N88-29255 #
ETN-88-92913 ..... N88-29190 #
ETN-88-92914 ..... N88-28955 #
ETN-88-92915 ..... N88-28958 #
ETN-88-92916 ..... N88-28957 #
ETN-88-92917 ..... N88-28963 #
ETN-88-92918 ..... N88-29349 #
ETN-88-92920 ..... N88-28952 #
ETN-88-92924 ..... N88-28890 #
ETN-88-92929 ..... N88-29241 #
ETN-88-92930 ..... N88-29242 #
ETN-88-92933 ..... N88-28911 #
ETN-88-92965 ..... N88-28932 #
ETN-88-92966 ..... N88-28979 #
ETN-88-92969 ..... N88-29224 #
ETN-88-92970 ..... N88-29129 #
ETN-88-92971 ..... N88-28899 #
ETN-88-92972 ..... N88-29073
ETN-88-92973 ..... N88-29074
ETN-88-92974 ..... N88-29075
ETN-88-92975 ..... N88-29147 #
ETN-88-92976 ..... N88-29130 #
ETN-88-92977 ..... N88-29178 #
ETN-88-92978 ..... N88-29131 #
ETN-88-92979 ..... N88-28912 #
ETN-88-92980 ..... N88-29651 #
ETN-88-92981 ..... N88-29616 #
ETN-88-92982 ..... N88-29015 #
ETN-88-92983 ..... N88-29122 #
ETN-88-92984 ..... N88-29096 #
ETN-88-92985 ..... N88-29617 #
ETN-88-92988 ..... N88-29223 #
ETN-88-92989 ..... N88-28953 #
ETN-88-92991 ..... N88-28905 #
ETN-88-93012 ..... N88-29123 #
ETN-88-93049 ..... N88-29245 #
ETN-88-93052 ..... N88-29189 #
ETN-88-93055 ..... N88-28913 #
ETN-88-93124 ..... N88-29206
ETN-88-93125 ..... N88-29179
ETN-88-93131 ..... N88-29549 #
ETN-88-93132 ..... N88-29350 #
ETN-88-93133 ..... N88-29097 #
ETN-88-93134 ..... N88-29307 #
ETN-88-93135 ..... N88-29308 #
ETN-88-93136 ..... N88-29436 #
ETN-88-93137 ..... N88-28906 #
ETN-88-93138 ..... N88-29309 #
ETN-88-93141 ..... N88-29524
ETN-88-93142 ..... N88-29148
ETN-88-93143 ..... N88-29479 #
ETN-88-93144 ..... N88-29629 #
ETN-88-93145 ..... N88-29630 #
ETN-88-93146 ..... N88-28907

FCT-5 ..... N88-29155 #

FFA-TN-1988-02 ..... N88-29126 #
FFA-TN-1988-13 ..... N88-29519 #
FFA-TN-1988-15 ..... N88-29520 #
FFA-TN-1988-17 ..... N88-29521 #

FMRL-TR-2 ..... N88-28886 #

GAO/NSIAD-88-22 ..... N88-29632 #

GB-PATENT-APPL-SN-8705827 ..... N88-29206
GB-PATENT-APPL-SN-8716748 ..... N88-29179

GB-PATENT-2-188-163-A N88-29206
GB-PATENT-2-192-689-A N88-29179

GRI-87/0297 ..... N88-29215 #
GRI-88/0056 ..... N88-29207 #

GRL/8703 ..... N88-29165 #

GTRI-A-4699-1 ..... N88-28973 #

HDL-TM-88-7 ..... N88-29330 #

HDL-TR-2130 ..... N88-29511 #
HDL-TR-2136 ..... N88-29599 #

HSER-9251 ..... N88-28928* #

IAF-86-82 ..... N88-29352* #

IC-86/332 ..... N88-29526 #
IC-86/351 ..... N88-29219 #
IC-87/33 ..... N88-29573 #
IC-87/60 ..... N88-29525 #
IC-87/100 ..... N88-29120 #
IC-87/104 ..... N88-29035 #
IC-87/109 ..... N88-29167 #
IC-87/126 ..... N88-29503 #
IC-87/163 ..... N88-29574 #
IC-87/168 ..... N88-29624 #
IC-87/174 ..... N88-29576 #
IC-87/179 ..... N88-29603 #
IC-87/181 ..... N88-29507 #
IC-87/187 ..... N88-29625 #
IC-87/210 ..... N88-29626 #
IC-87/218 ..... N88-29604 #
IC-87/278 ..... N88-29605 #
IC-87/284 ..... N88-29606 #
IC-87/285 ..... N88-29168 #
IC-87/286 ..... N88-29650 #
IC-87/289 ..... N88-29607 #
IC-87/294 ..... N88-29508 #
IC-87/320 ..... N88-29627 #
IC-87/325 ..... N88-29014 #
IC-87/331 ..... N88-29512 #
IC-87/334 ..... N88-29252 #
IC-87/336 ..... N88-29608 #
IC-87/337 ..... N88-29609 #
IC-87/339 ..... N88-29610 #
IC-87/340 ..... N88-29070 #
IC-87/341 ..... N88-29071 #
IC-87/342 ..... N88-29072 #
IC-87/343 ..... N88-29611 #
IC-87/344 ..... N88-29472 #
IC-87/350 ..... N88-29612 #
IC-87/363 ..... N88-29253 #
IC-87/364 ..... N88-29254 #

ICOMP-88-12 ..... N88-29195* #

IDA-M-360 ..... N88-29335 #
IDA-M-405 ..... N88-29161 #

IDA-P-2035 ..... N88-29494 #
IDA-P-2068 ..... N88-29495 #

IDA/HQ-87-32185 ..... N88-29495 #
IDA/HQ-87-32623 ..... N88-29494 #
IDA/HQ-87-32693 ..... N88-29335 #
IDA/HQ-87-32921 ..... N88-29161 #

IFUSP-P-636 ..... N88-29473 #

ILR-MITT-193 ..... N88-29123 #

INIS-BR-965 ..... N88-29196 #
INIS-BR-967 ..... N88-29174 #
INIS-BR-969 ..... N88-29007 #
INIS-BR-1015 ..... N88-29999 #
INIS-BR-1016 ..... N88-29000 #
INIS-BR-1031 ..... N88-29157 #
INIS-BR-1037 ..... N88-29590 #
INIS-BR-1043 ..... N88-29591 #
INIS-BR-1061 ..... N88-29592 #
INIS-BR-1062 ..... N88-29593 #
INIS-BR-1080 ..... N88-29188 #
INIS-BR-1102 ..... N88-29613 #

INIS-SU-26 ..... N88-29056 #

INS-845 ..... N88-29707 #
INS-853 ..... N88-29588 #

INT-PATENT-CLASS-F16F-1/26 ..... N88-29179

INT-PATENT-CLASS-G01N3/18 ..... N88-29206

IPPJ-851 ..... N88-29706 #

ISBN-0-86-039330-5 ..... N88-28898
ISBN-90-9002053-5 ..... N88-29536 #
ISBN-92-835-0451-8 ..... N88-29313 #
ISBN-92-835-0456-9 ..... N88-29291 #
ISBN-92-835-0457-7 ..... N88-28857 #
ISBN-92-835-0468-2 ..... N88-28893 #
ISBN-92-835-0475-5 ..... N88-28926 #

ISI-108 ..... N88-29439 #

ISSN-90-71382-11-7 ..... N88-29548 #
ISSN-0065-3713 ..... N88-29228
ISSN-0065-3713 ..... N88-29243
ISSN-0065-3713 ..... N88-29709
ISSN-0082-5255 ..... N88-28970 #
ISSN-0082-5255 ..... N88-29586 #
ISSN-0143-7135 ..... N88-29148
ISSN-0143-7143 ..... N88-29524
ISSN-0171-1342 ..... N88-28890 #
ISSN-0171-1342 ..... N88-28911 #

ISSN-0171-1342 ..... N88-28952 #
ISSN-0171-1342 ..... N88-29241 #
ISSN-0171-1342 ..... N88-29242 #
ISSN-0250-1589 ..... N88-29713 #
ISSN-0348-7539 ..... N88-29244 #
ISSN-0379-4059 ..... N88-29190 #
ISSN-0436-1199 ..... N88-29130 #
ISSN-0436-1199 ..... N88-29147 #
ISSN-0436-1199 ..... N88-29178 #
ISSN-0951-6301 ..... N88-28907

ISVR-TR-151 ..... N88-29522 #
ISVR-TR-153 ..... N88-29523 #

IS0001F ..... N88-29649 #

ITEP-21(1986) ..... N88-29710 #
ITEP-82(1986) ..... N88-29705 #

JAERI-M-87-185 ..... N88-29023 #
JAERI-M-87-214 ..... N88-29589 #

JINR-E-2-87-209 ..... N88-29619 #
JINR-E-2-87-325 ..... N88-29620 #
JINR-E-2-87-420 ..... N88-29053 #
JINR-E-4-86-577 ..... N88-29570 #

JINR-R-13-87-404 ..... N88-29232 #

JPL-PUBL-88-11 ..... N88-29328* #

JSR-84-105 ..... N88-29529 #

K/QT-141 ..... N88-29173 #

KFTI-87-37 ..... N88-29563 #

KTM/E-D-120 ..... N88-29218 #

L-16082 ..... N88-28895* #
L-16472 ..... N88-28879* #
L-16473 ..... N88-29234* #

LA-UR-88-194 ..... N88-29038 #
LA-UR-88-625 ..... N88-29197 #
LA-UR-88-642 ..... N88-29580 #
LA-UR-88-1070 ..... N88-29063 #
LA-UR-88-1470 ..... N88-29510 #
LA-UR-88-1545 ..... N88-29537 #
LA-UR-88-1643 ..... N88-29554 #
LA-UR-88-1671 ..... N88-28987 #

LA-11178-MS ..... N88-29560 #
LA-11244-MS ..... N88-28948 #

LBL-23946 ..... N88-29581 #
LBL-24068 ..... N88-29558 #
LBL-24092 ..... N88-29217 #
LBL-24442 ..... N88-29571 #
LBL-24891 ..... N88-29138 #

LCDS/CCS-87-40 ..... N88-29496 #
LCDS/CCS-88-2 ..... N88-29442 #

LFD-262 ..... N88-29073
LFD-267 ..... N88-29074
LFD-269 ..... N88-29075

LMSC-HEC-TR-F225772 ..... N88-29115* #

LPI-CONTRIB-88-05 ..... N88-29654* #

M-577 ..... N88-29351* #

MATH-REPT-207 ..... N88-29479 #
MATH-REPT-208 ..... N88-29629 #
MATH-REPT-209 ..... N88-29630 #

MBB-URV-170/87 ..... N88-28963 #

MBB-UT-104/88 ..... N88-28932 #

MCR-TR-8711/12-1 ..... N88-28923 #

MDC-QA005 ..... N88-28889 #

MIS-8712001 ..... N88-29177 #

MIT-EL-88-001 ..... N88-29024 #

MIT/LCS/TM-349 ..... N88-29333 #

MPIS-13/1987 ..... N88-29147 #
MPIS-14/1987 ..... N88-29130 #
MPIS-16/1987 ..... N88-29178 #

MRC/ABQ-R-1039 ..... N88-29555 #

NADC-87169-60 ..... N88-28925 #
NADC-88014-60 ..... N88-28908 #

NAE-AN-50 ..... N88-29058 #

NAS 1.15:4066 ..... N88-29256* #
NAS 1.15:4074 ..... N88-28879* #
NAS 1.15:86426-PT-1 ..... N88-29259* #
NAS 1.15:86426-PT-2 ..... N88-29260* #
NAS 1.15:86426-PT-3 ..... N88-29261* #
NAS 1.15:88206 ..... N88-28918* #
NAS 1.15:100649 ..... N88-29489* #
NAS 1.15:100664 ..... N88-28892* #
NAS 1.15:100670 ..... N88-28982* #
NAS 1.15:100924 ..... N88-28942* #
NAS 1.15:100928 ..... N88-29195* #
NAS 1.15:100956 ..... N88-28980* #
NAS 1.15:100966 ..... N88-29142* #
NAS 1.15:100994 ..... N88-29455* #
NAS 1.15:101306 ..... N88-29152* #
NAS 1.15:101315 ..... N88-28959* #
NAS 1.15:101325 ..... N88-28966* #
NAS 1.26:3902 ..... N88-29258* #
NAS 1.26:3914 ..... N88-28983* #
NAS 1.26:3992 ..... N88-28894* #
NAS 1.26:4173 ..... N88-28933* #
NAS 1.26:4178 ..... N88-28880* #
NAS 1.26:4182 ..... N88-28891* #
NAS 1.26:172052 ..... N88-28944* #
NAS 1.26:172069 ..... N88-29044* #
NAS 1.26:172070 ..... N88-29045* #
NAS 1.26:172074 ..... N88-28949* #
NAS 1.26:172587 ..... N88-28915* #
NAS 1.26:172588 ..... N88-28916* #
NAS 1.26:174791 ..... N88-28928* #
NAS 1.26:174959 ..... N88-28927* #
NAS 1.26:175104 ..... N88-28917* #
NAS 1.26:177435 ..... N88-28882* #
NAS 1.26:178415-VOL-2-PT-1 ..... N88-28881* #
NAS 1.26:178973 ..... N88-28964* #
NAS 1.26:178974 ..... N88-28965* #
NAS 1.26:179020 ..... N88-29184* #
NAS 1.26:179371 ..... N88-28950* #
NAS 1.26:179468 ..... N88-28930* #
NAS 1.26:179498 ..... N88-29077* #
NAS 1.26:179521 ..... N88-28929* #
NAS 1.26:179886 ..... N88-29480* #
NAS 1.26:180484 ..... N88-29116* #
NAS 1.26:180776 ..... N88-28947* #
NAS 1.26:180777 ..... N88-29136* #
NAS 1.26:180947 ..... N88-29210* #
NAS 1.26:181459 ..... N88-29708* #
NAS 1.26:181590 ..... N88-28919* #
NAS 1.26:181636 ..... N88-29115* #
NAS 1.26:181678 ..... N88-29431* #
NAS 1.26:182443 ..... N88-29653* #
NAS 1.26:182516 ..... N88-29328* #
NAS 1.26:182905 ..... N88-29481* #
NAS 1.26:182951 ..... N88-29311* #
NAS 1.26:183075 ..... N88-29654* #
NAS 1.26:183077 ..... N88-29514* #
NAS 1.26:183106 ..... N88-29106* #
NAS 1.26:183109 ..... N88-29327* #
NAS 1.26:183114 ..... N88-29196* #
NAS 1.26:183121 ..... N88-29231* #
NAS 1.26:183122 ..... N88-28896* #
NAS 1.26:183203 ..... N88-29257* #
NAS 1.26:183204 ..... N88-28981* #
NAS 1.55:3007 ..... N88-29351* #
NAS 1.60:2594 ..... N88-28895* #
NAS 1.61:1202 ..... N88-29652* #
NAS 1.61:1208 ..... N88-29233* #
NAS 1.61:1209 ..... N88-29234* #
NAS 1.71:GSC-13112-1 ..... N88-29050* #
NAS 1.71:LAR-13607-1-CU ..... N88-29048* #
NAS 1.71:LAR-13638-1 ..... N88-29051* #
NAS 1.71:LAR-13710-1 ..... N88-29145* #
NAS 1.71:LAR-13817-1 ..... N88-29012* #
NAS 1.71:MFS-28281-1 ..... N88-28938* #
NAS 1.71:MFS-28282-1 ..... N88-29602* #
NAS 1.71:NPO-17233-1-CU ..... N88-29095* #
NAS 1.71:NPO-17310-1-CU ..... N88-28946* #
NAS 1.77:20197 ..... N88-29183* #
NAS 1.77:20243 ..... N88-29182* #
NAS 1.77:20293 ..... N88-28900* #
NAS 1.77:20304 ..... N88-29041* #
NAS 1.77:20307 ..... N88-29631* #
NAS 1.77:20329 ..... N88-29134* #
NAS 1.77:20332 ..... N88-29003* #
NAS 1.77:20335 ..... N88-29618* #
NAS 1.77:20341 ..... N88-29135* #
NAS 1.77:20354 ..... N88-29098* #

NASA-CASE-ARC-11636-1 ..... N88-28914*

NASA-CASE-ARC-11649-1-SB N88-29040*

NASA-CASE-GSC-13019-1 ..... N88-29133*
NASA-CASE-GSC-13112-1 ..... N88-29050* #

NASA-CASE-LAR-13528-1 ..... N88-29002*
NASA-CASE-LAR-13607-1-CU ..... N88-29048* #
NASA-CASE-LAR-13638-1 ..... N88-29051* #
NASA-CASE-LAR-13710-1 ..... N88-29145* #
NASA-CASE-LAR-13776-1 ..... N88-29149*
NASA-CASE-LAR-13817-1 ..... N88-29012* #
NASA-CASE-LAR-13826-1 ..... N88-29150*

NASA-CASE-LEW-14374-1 ..... N88-28939*

NASA-CASE-MFS-28281-1 ..... N88-28938* #
NASA-CASE-MFS-28282-1 ..... N88-29602* #

NASA-CASE-MSC-18172-3 ..... N88-29052*
NASA-CASE-MSC-20640-1 ..... N88-29132*
NASA-CASE-MSC-21117-1 ..... N88-28958*
NASA-CASE-MSC-21132-1 ..... N88-29181*
NASA-CASE-MSC-21207-1 ..... N88-29180*

NASA-CASE-NPO-16116-2 ..... N88-29310*
NASA-CASE-NPO-17068-1-CU N88-29151*
NASA-CASE-NPO-17196-1-CU N88-29078*
NASA-CASE-NPO-17233-1-CU ..... N88-29095* #
NASA-CASE-NPO-17310-1-CU ..... N88-28946* #

NASA-CP-3007 ..... N88-29351* #

NASA-CR-3902 ..... N88-29258* #
NASA-CR-3914 ..... N88-28983* #
NASA-CR-3992 ..... N88-28894* #
NASA-CR-4173 ..... N88-28933* #
NASA-CR-4178 ..... N88-28880* #
NASA-CR-4182 ..... N88-28891* #
NASA-CR-172052 ..... N88-28944* #
NASA-CR-172069 ..... N88-29044* #
NASA-CR-172070 ..... N88-29045* #
NASA-CR-172074 ..... N88-28949* #
NASA-CR-172587 ..... N88-28915* #
NASA-CR-172588 ..... N88-28916* #
NASA-CR-174791 ..... N88-28928* #
NASA-CR-174959 ..... N88-28927* #
NASA-CR-175104 ..... N88-28917* #
NASA-CR-177435 ..... N88-28882* #
NASA-CR-178415-VOL-2-PT-1 ..... N88-28881* #
NASA-CR-178973 ..... N88-28964* #
NASA-CR-178974 ..... N88-28965* #
NASA-CR-179020 ..... N88-29184* #
NASA-CR-179371 ..... N88-28950* #
NASA-CR-179468 ..... N88-28930* #
NASA-CR-179498 ..... N88-29077* #
NASA-CR-179521 ..... N88-28929* #
NASA-CR-179886 ..... N88-29480* #
NASA-CR-180484 ..... N88-29116* #
NASA-CR-180776 ..... N88-28947* #
NASA-CR-180777 ..... N88-29136* #
NASA-CR-180947 ..... N88-29210* #
NASA-CR-181459 ..... N88-29708* #
NASA-CR-181590 ..... N88-28919* #
NASA-CR-181636 ..... N88-29115* #
NASA-CR-181678 ..... N88-29431* #
NASA-CR-182443 ..... N88-29653* #
NASA-CR-182516 ..... N88-29328* #
NASA-CR-182905 ..... N88-29481* #
NASA-CR-182951 ..... N88-29311* #
NASA-CR-183075 ..... N88-29654* #
NASA-CR-183077 ..... N88-29514* #
NASA-CR-183106 ..... N88-29106* #
NASA-CR-183109 ..... N88-29327* #
NASA-CR-183114 ..... N88-29196* #
NASA-CR-183121 ..... N88-29231* #
NASA-CR-183122 ..... N88-28896* #
NASA-CR-183203 ..... N88-29257* #
NASA-CR-183204 ..... N88-28981* #

NASA-RP-1202 ..... N88-29652* #
NASA-RP-1208 ..... N88-29233* #
NASA-RP-1209 ..... N88-29234* #

NASA-TM-4066 ..... N88-29256* #
NASA-TM-4074 ..... N88-28879* #
NASA-TM-86426-PT-1 ..... N88-29259* #
NASA-TM-86426-PT-2 ..... N88-29260* #
NASA-TM-86426-PT-3 ..... N88-29261* #
NASA-TM-88206 ..... N88-28918* #
NASA-TM-100649 ..... N88-29489* #
NASA-TM-100664 ..... N88-28892* #
NASA-TM-100670 ..... N88-28982* #
NASA-TM-100924 ..... N88-28942* #
NASA-TM-100928 ..... N88-29195* #
NASA-TM-100956 ..... N88-28980* #
NASA-TM-100966 ..... N88-29142* #

NASA-TM-100994 ..... N88-29455* #
NASA-TM-101306 ..... N88-29152* #
NASA-TM-101315 ..... N88-28959* #
NASA-TM-101325 ..... N88-28966* #

NASA-TP-2594 ..... N88-28895* #

NASA-TT-20197 ..... N88-29183* #
NASA-TT-20243 ..... N88-29182* #
NASA-TT-20293 ..... N88-29000* #
NASA-TT-20304 ..... N88-29041* #
NASA-TT-20307 ..... N88-29031* #
NASA-TT-20329 ..... N88-29134* #
NASA-TT-20332 ..... N88-29003* #
NASA-TT-20335 ..... N88-29018* #
NASA-TT-20341 ..... N88-29135* #
NASA-TT-20354 ..... N88-29098* #

NCEL-CR-88.010 ..... N88-29059 #

NOSC/TD-1250 ..... N88-29087 #

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NOSC/TR-1217 ..... N88-29517 #

NPL-AC-114 ..... N88-29524

NPL-RS(EXT)-93 ..... N88-29148

NPRDC-TN-88-37 ..... N88-29289 #

NPS52-88-002 ..... N88-28940 #
NPS67-88-001 ..... N88-29112 #

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POLY-WRI-1533-88 ..... N88-29079 #

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PROG-87015308 ..... N88-29215 #

R/D-4410-EE-01 ..... N88-29601 #
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R/D-5653-PH-01 ..... N88-29623 #
R/D-5823-MS-01 ..... N88-29020 #
R/D-5859-PH-01 ..... N88-29530 #

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RADC-TR-87-132 ..... N88-29438 #
RADC-TR-87-139 ..... N88-29066 #
RADC-TR-87-249-VOL-1 ..... N88-29447 #
RADC-TR-87-279 ..... N88-29032 #
RADC-TR-88-72 ..... N88-29089 #

RAND/N-2457-AF ..... N88-29249 #

REPT-5-87 ..... N88-29073
REPT-5-32935 ..... N88-29137 #
REPT-10-87 ..... N88-29074
REPT-12-87 ..... N88-29075
REPT-88-1-ONR ..... N88-29483 #
REPT-88B0152 ..... N88-29652* #
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REPT-205 ..... N88-29476 #
REPT-206 ..... N88-29568 #
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REPT-1149 ..... N88-29282 #

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RSRE-MEMO-4148 ..... N88-29436 #

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R86AEB564 ..... N88-28929* #
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SAND-87-2761C ..... N88-29006 #
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SAND-87-7025 ..... N88-29221 #
SAND-88-0234C ..... N88-29214 #
SAND-88-0250C ..... N88-29082 #
SAND-88-0680 ..... N88-29176 #
SAND-88-1197C ..... N88-29578 #
SAND-88-1324C ..... N88-29213 #
SAND-88-1518C ..... N88-28988 #
SAND-88-8215 ..... N88-29304 #

SASR-9 ..... N88-29653* #

SCC-R-102-3 ..... N88-29487 #

SC5345.AR ..... N88-29597 #

SD-TR-88-28 ..... N88-29018 #
SD-TR-88-54 ..... N88-29527 #

SDC-TM-3628 ..... N88-29339 #

SERI/STR-217-3203 ..... N88-29212 #
SERI/STR-217-3287 ..... N88-29211 #

SERI/TP-211-3354 ..... N88-29220 #

SNIAS-881-320-103 ..... N88-29449 #
SNIAS-881-422-102 ..... N88-28943 #
SNIAS-881-430-104 ..... N88-28977 #
SNIAS-881-430-105 ..... N88-29189 #
SNIAS-881-430-106 ..... N88-28978 #
SNIAS-881-430-107 ..... N88-29146 #
SNIAS-881-430-114 ..... N88-29037 #
SNIAS-881-430-115 ..... N88-29569 #
SNIAS-881-430-119 ..... N88-28969 #
SNIAS-881-430-122 ..... N88-29038 #
SNIAS-881-440-103 ..... N88-29127 #
SNIAS-881-440-104 ..... N88-29126 #
SNIAS-881-440-113 ..... N88-28954 #

SRA-R88-930015-F ..... N88-29110 #

SRB-CLE-F-VOL-1 ..... N88-28964* #
SRB-CLE-F-VOL-2-APP-A ..... N88-28965* #

SRI-ECU-6975 ..... N88-29067 #

SSI-TR-134 ..... N88-28945 #

TACOM-TR-13323 ..... N88-29302 #

TKK-KO/LVI-B14 ..... N88-29049 #

TR-11 ..... N88-29019 #
TR-84-47 ..... N88-29490 #
TR-87-13 ..... N88-28922 #
TR-87-14 ..... N88-28921 #
TR-88-1 ..... N88-29450 #
TR-88-12 ..... N88-29484 #
TR-019 ..... N88-29031 #
TR-222 ..... N88-29456 #
TR-226 ..... N88-29460 #
TR-0086A(2935-12)-3 ..... N88-29018 #
TR-0088(3930-04)-1 ..... N88-29527 #

TRITA-EPP-88-01 ..... N88-29244 #

TR87-039 ..... N88-29341 #
TR88-004 ..... N88-29466 #

U-5/88 ..... N88-29020 #

UBUFFALO/DC/88/TR-68 ..... N88-28997 #

UCB/ERL-M-88/21 ..... N88-29553 #
UCB/ERL-M-88/23 ..... N88-29564 #

UCRL-96555-REV-1 ..... N88-28964 #
UCRL-97218 ..... N88-29579 #
UCRL-98391-REV-1 ..... N88-29552 #
UCRL-98784 ..... N88-29544 #

UDR-TR-87-71 ..... N88-29199 #
UDR-TR-87-82 ..... N88-29034 #
UDR-TR-87-95 ..... N88-28887 #

UIC-EECS-87-3 ..... N88-29086 #

UILU-ENG-88-2218 ..... N88-29501 #

ULRF-440/CAR ..... N88-29237 #

US-PATENT-APPL-SN-004282 ..... N88-29310*
US-PATENT-APPL-SN-032818 ..... N88-29180*
US-PATENT-APPL-SN-054980 ..... N88-29149*
US-PATENT-APPL-SN-060200 ..... N88-28939*
US-PATENT-APPL-SN-076956 ..... N88-29151*
US-PATENT-APPL-SN-084770 ..... N88-29076*
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US-PATENT-APPL-SN-210487 ..... N88-29145* #
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US-PATENT-APPL-SN-684186 ..... N88-29150*
US-PATENT-APPL-SN-755960 ..... N88-29052*
US-PATENT-APPL-SN-846429 ..... N88-29149*
US-PATENT-APPL-SN-890577 ..... N88-29040*
US-PATENT-APPL-SN-890982 ..... N88-29150*
US-PATENT-APPL-SN-898449 ..... N88-29052*
US-PATENT-APPL-SN-929875 ..... N88-28958*
US-PATENT-APPL-SN-933962 ..... N88-29002*
US-PATENT-APPL-SN-933963 ..... N88-28914*
US-PATENT-APPL-SN-942158 ..... N88-29133*
US-PATENT-APPL-SN-943346 ..... N88-29132*

US-PATENT-CLASS-52-646 ..... N88-28958*
US-PATENT-CLASS-52-646 ..... N88-29180*
US-PATENT-CLASS-52-648 ..... N88-28958*
US-PATENT-CLASS-52-648 ..... N88-29180*
US-PATENT-CLASS-60-203.1 ..... N88-28939*
US-PATENT-CLASS-60-527 ..... N88-29151*
US-PATENT-CLASS-73-290-R N88-29150*
US-PATENT-CLASS-73-304-R N88-29150*
US-PATENT-CLASS-122-366 ..... N88-29133*
US-PATENT-CLASS-138-38 ..... N88-29133*
US-PATENT-CLASS-165-81 ..... N88-29132*
US-PATENT-CLASS-165-104.26 ..... N88-29133*
US-PATENT-CLASS-165-170 ..... N88-29132*
US-PATENT-CLASS-165-905 ..... N88-29133*
US-PATENT-CLASS-188-218-XL N88-29181*
US-PATENT-CLASS-188-251-A N88-29181*
US-PATENT-CLASS-210-500.25 ..... N88-29052*
US-PATENT-CLASS-210-500.35 ..... N88-29052*
US-PATENT-CLASS-210-639 ..... N88-29052*
US-PATENT-CLASS-210-653 ..... N88-29052*
US-PATENT-CLASS-219-383 ..... N88-28939*
US-PATENT-CLASS-236-15-E N88-29002*
US-PATENT-CLASS-244-12.3 ..... N88-28914*
US-PATENT-CLASS-244-12.4 ..... N88-28914*
US-PATENT-CLASS-244-45-A N88-28914*
US-PATENT-CLASS-244-55 ..... N88-28914*
US-PATENT-CLASS-244-134-F N88-29149*
US-PATENT-CLASS-244-207 ..... N88-28914*
US-PATENT-CLASS-324-61-R N88-29149*
US-PATENT-CLASS-328-155 ..... N88-29076*
US-PATENT-CLASS-331-17 ..... N88-29076*
US-PATENT-CLASS-331-25 ..... N88-29076*
US-PATENT-CLASS-340-580 ..... N88-29149*
US-PATENT-CLASS-363-97 ..... N88-28939*
US-PATENT-CLASS-364-200 ..... N88-29310*
US-PATENT-CLASS-364-500 ..... N88-29002*
US-PATENT-CLASS-364-557 ..... N88-29002*
US-PATENT-CLASS-364-571 ..... N88-29002*
US-PATENT-CLASS-374-36 ..... N88-29002*
US-PATENT-CLASS-403-171 ..... N88-29180*
US-PATENT-CLASS-403-217 ..... N88-29180*
US-PATENT-CLASS-427-245 ..... N88-29052*
US-PATENT-CLASS-431-13 ..... N88-29002*
US-PATENT-CLASS-431-76 ..... N88-29002*
US-PATENT-CLASS-501-88 ..... N88-29040*
US-PATENT-CLASS-501-91 ..... N88-29040*
US-PATENT-CLASS-501-92 ..... N88-29040*
US-PATENT-CLASS-501-93 ..... N88-29040*
US-PATENT-CLASS-528-4 ..... N88-29040*
US-PATENT-CLASS-528-10 ..... N88-29040*
US-PATENT-CLASS-528-30 ..... N88-29040*

US-PATENT-4,761,744 ..... N88-29002*

US-PATENT-4,762,173 ..... N88-29132*
US-PATENT-4,762,619 ..... N88-29052*
US-PATENT-4,763,459 ..... N88-29180*
US-PATENT-4,763,762 ..... N88-29181*
US-PATENT-4,765,114 ..... N88-28958*
US-PATENT-4,765,139 ..... N88-29151*
US-PATENT-4,765,187 ..... N88-29150*
US-PATENT-4,765,396 ..... N88-29133*
US-PATENT-4,766,369 ..... N88-29149*
US-PATENT-4,766,533 ..... N88-29310*
US-PATENT-4,766,724 ..... N88-28939*
US-PATENT-4,767,063 ..... N88-28914*
US-PATENT-4,767,728 ..... N88-29040*
US-PATENT-4,771,250 ..... N88-29076*

USAFSAM-TR-87-9 ..... N88-29265 #

USARIEM-M-11/88 ..... N88-29270 #
USARIEM-M-12/88 ..... N88-29271 #
USARIEM-M-31/88 ..... N88-29272 #

USARIEM-T-11/88 ..... N88-29274 #

USCG-ONSCEN-02-87 ..... N88-28902 #

USCMI-87-66 ..... N88-29491 #
USCMI-88-12 ..... N88-29277 #

USIP-88-02 ..... N88-29628 #

UTIAS-324 ..... N88-28970 #
UTIAS-325 ..... N88-29566 #

UTRC-R86-956480-VOL-3 ..... N88-28930* #

UVA/525415/EE88/113 ..... N88-29060 #

UWA/DME/TR-88/59 ..... N88-29202 #

VKI-NT-164 ..... N88-29124 #

VKI-TN-166 ..... N88-29125 #

W-87-02 ..... N88-29477 #
W-87-16 ..... N88-29478 #

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